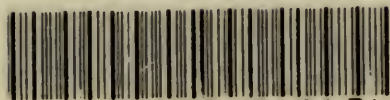


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BULLETINS

Nos. 397 to 415

Issued by the Ontario Department of Agriculture



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BULLETIN 397

FEBRUARY, 1939

Ontario Department of Agriculture

Statistics and Publications Branch

TORONTO, ONTARIO

Common Edible and Poisonous

MUSHROOMS OF ONTARIO

Mushroom Growing

Diseases of Mushrooms and their Control

By

R. E. STONE, PH.D., ASSOCIATE PROFESSOR OF BOTANY
Ontario Agricultural College, Guelph

Price 10 Cents

COMMON EDIBLE AND POISONOUS

Mushrooms of Ontario

With Notes on the Culture of Mushrooms

By R. E. STONE, B.Sc., M.Sc., Ph.D.

Associate Professor of Botany

INTRODUCTION

Every year many inquiries are received regarding the identity and edibility of wild, that is, uncultivated mushrooms and other fleshy fungi. Evidently a very considerable number of people are interested in these less familiar plants of our fields and woodlands. It is hoped that the photographs and descriptions presented in this bulletin will enable lovers of mushrooms to collect and enjoy a wider range of these delicacies than they have in the past and at the same time to learn to avoid the poisonous forms.

Also many inquiries are received regarding the growing of mushrooms, either for family use or for commercial purposes. It is beyond the scope of this bulletin to discuss the methods used in large commercial establishments, but it is hoped that the discussion of the principles of mushroom growing may be useful to those who wish to grow them on a small scale for home use or for sale in small quantities.

WHAT MUSHROOMS ARE

All of us are acquainted with green plants such as trees, flowers and grass, and when we think of plants it is these which we have in mind. But there are many other plants which are not green and which do not produce flowers or seeds, and are often more or less inconspicuous. They are associated with the spoiling and decay of food, wood, etc. When a

piece of bread is left in a warm, moist place, it soon becomes covered with blue or black mould. This mould is a plant belonging to a class of plants known as fungi. In like manner, wood, straw or leaves if kept moist, are soon covered with a growth of fungi which may form large, woody or fleshy masses.

The term mushroom is used to mean these large, woody, or fleshy fungi. They may be seen growing on the trunks of trees, on stumps, or fallen logs, coming out of the leaf mould on the forest floor, or in the grass in yards, lawns, fields and pastures or along the roadside. The plants may look like round balls, or shelves or brackets, or caps supported on slender stems or branched and coral-like. In colour they may vary from white through pink, red, yellow, blue, brown to nearly black, but never grass green.

It is seldom that we see the entire plant. The part we usually see is the fruiting body, which compares to the whole plant much as an apple to an apple tree. The feeding part, called the spawn or mycelium, consists of fine white or coloured threads running all through the material upon which the plant is growing.

In this bulletin the term mushroom is used for all these fleshy growths irrespective of their edibility. The term toadstool is not used because it refers to the same class of plants; the only difference being in the knowledge of the collector, who commonly refers to mushrooms as those fruit bodies he considers edible, and who calls all forms which he suspects of being poisonous or inedible as toadstools.

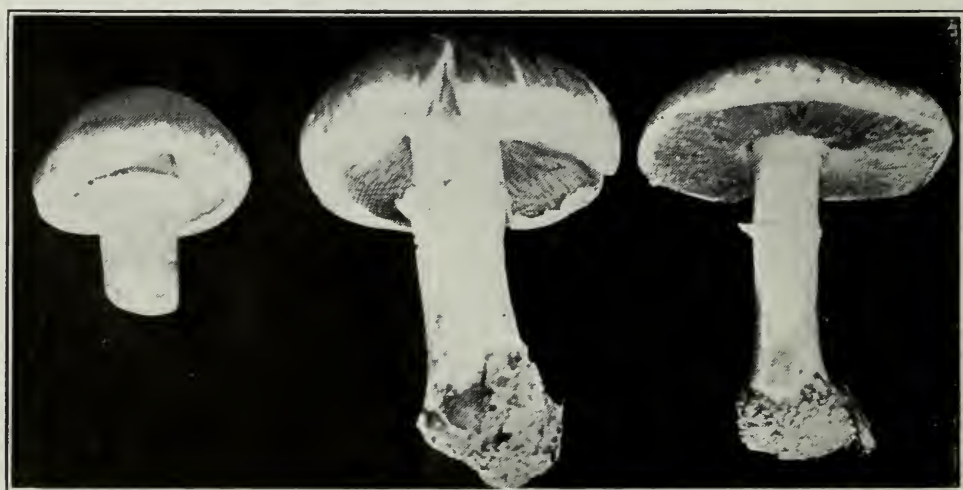


FIG. 1.—Common or Cultivated Mushroom. Edible. Natural Size (Original).

PARTS OF A MUSHROOM

In order to understand the structure of the mushroom let us examine the common cultivated kind. (Fig. 1.)

What we commonly call a "mushroom" is the fruit body of a fungus growing in decaying organic matter such as old leaves, straw, rotting stable refuse. This fruit body consists of a fleshy cap or pileus two or three inches in diameter supported on a stalk or stipe which comes up out of the ground. This stalk is three or four inches long and one-half inch thick and quite solid. On the under side of the cap are the gills or lamellae. These are thin plates standing on edge and radiating out from the stalk like the spokes of a wheel. In a young fruit, called a button, these gills are protected by a curtain or veil which stretches from the stalk to the edge of the cap. As the cap expands the veil is torn apart, a little of it remaining as a ragged fringe on the edge of the cap, but most of it remaining as a ring or annulus on the stalk or stipe.

HOW MUSHROOMS GROW

Mushrooms are flowerless plants without leaf green (chlorophyll). Since they have no flowers they have no seed, but reproduce by means of minute bodies called spores, which are formed on the gills. As they have no leaf green (chlorophyll), they cannot make their own food as the green plants do, so they depend upon the food made by other plants or upon animals. Some obtain their food from living plants and animals; they are robbers (parasites). Others live in the dead remains of other plants, upon dead animals or animal refuse and excrement. These kinds cause decay and disintegration of organic material and are scavengers (saprophytes). Most of the larger fungi belong in this latter class.

The food for the growth of the large fruit body is secured by the mycelium or spawn which spreads all through the available organic material. After the spawn has grown for some time the fruit bodies or mushrooms are formed.

When the "mushroom" or fruit body is ripe the spores are shed and are blown away by the wind. If the spores settle in a favourable place, warm, moist and with food present, they sprout or germinate. Finally they form many fine white or coloured threads which spread all through the material which can furnish food. These fine threads are the spawn or mycelium. As the spawn grows it gives off substances called enzymes, which digest the wood, old leaves, straw or manure in which the fungus is growing. As the material is digested it is absorbed by the spawn and used as food. The substance upon which the fungus is feeding gradually breaks down, that is it decays and disappears.

The spawn may grow a long time before it fruits. Even in the cultivated mushroom, when conditions for growth are made as favourable as possible, it is usually six weeks from the time the spawn is planted until the "mushrooms" appear. In growing the cultivated mushroom this long cycle is avoided by planting viable spawn which is already well established in small masses of compost. We do not use spores.

When the spawn has gathered sufficient food it then begins to form the fruit bodies or "mushrooms." (See Fig. 2.) These at first are tiny white balls, smaller than a pin head. They grow rapidly in size, and when they are as large as a small marble one can recognize the main parts. In the top will be the cap, with the gills underneath, protected by the veil, while the lower part is the stalk or stipe. When the parts have all been formed the "mushroom" enlarges rapidly and pushes up out of the ground. Very frequently the stalk elongates so rapidly when the fruit body is nearly grown that the cap may be pushed up out of the ground during the night, so that some people have thought that these mushrooms grew in a night.



FIG. 2.—Button Stage of Common or Cultivated Mushroom. Natural Size (Original).

VARIATIONS FROM THE STRUCTURE OF THE COMMON MUSHROOM

Some of our very poisonous mushrooms have the button enclosed in a special sack or envelope. When the cap and stalk enlarge the sack or envelope is ruptured at the top and may be left at the base of the stalk or stipe as a distinct cup or bag and this cup or bag is called the poison-cup or volva. Very often this volva is deeply buried in the soil or leaf mould and unless care is taken in lifting the mushroom it may be torn off and one of the very important parts lost. This type of volva is shown in Figures 5 and 6.

In some other poisonous mushrooms the upper part of the envelope which encloses the button may be broken into many pieces and these pieces form loose separate scales which adhere slightly to the cap but may be easily brushed or washed away without tearing the tissue of the cap. Such a volva is shown in Figures 3 and 4.

In many wild mushrooms there is no ring nor poison cup. Both annulus and volva are lacking. Such a type is shown in Figures 12, 13, 14, 15.

Mushrooms which develop from the side of stumps or logs may not have a stalk or stipe, the cap being attached by one side. This condition is shown in Figures 22, 39, 40 and 41.

Some fungi which are considered in this Bulletin are simple balls of tissue while some others are greatly branched forms. See Figures 52-60.

WHEN AND WHERE TO LOOK FOR MUSHROOMS

Mushrooms may be found from the time the ground thaws out in the spring until it freezes up in the fall. They are most plentiful after prolonged wet weather or after warm rains when the days are warm and the nights fairly cool and damp. It is best to look for them on cool, dewy mornings, a day or two after warm heavy rains. Autumn is the time when mushrooms are most abundant but they may be found from the time the frost goes out of the ground in spring until it freezes hard again in late autumn or early winter.

They grow any place where there is plenty of decaying vegetable or animal material which is not too much disturbed by cultivation. Some kinds grow in rich, well-manured lawns, others in pastures, several varieties along the roadside. Some delicious kinds grow in barnyards. Many grow best in the woods, some in the leaf mould on the forest floor, some on stumps, some on fallen logs and a few on standing trees. City garbage dumps produce abundant crops of mushrooms, especially the Shaggy Mane and Ink Caps. Any golfer will tell you that they are only too abundant on golf courses.

GATHERING WILD MUSHROOMS

When one is gathering wild mushrooms a basket is the best receptacle for carrying them, as different compartments may be made for holding the various kinds, and thus keep from crushing and spoiling the more tender ones.

When collecting mushrooms for the table they should never be pulled up or broken off. In the deadly poisonous mushrooms the most marked characteristic, the poison cup or volva, is deeply buried in the soil. If the plant is pulled up or broken off the poison cup is lost, and it is impossible

to distinguish the poisonous kinds from certain edible ones. After a mushroom has been carefully dug up and examined and the collector is certain that it is edible, the lower part of the stalk may be cut off to get rid of the dirt. It is often very difficult to determine mushrooms from the young or button stage, so that unless buttons are accompanied by mature plants they should generally be avoided. In case of doubt the fungus should be discarded or the complete specimen shown to one who knows mushrooms very thoroughly.

RULES TO BE OBSERVED IN GATHERING WILD MUSHROOMS

It is impossible to give a simple rule or test for detecting poisonous mushrooms. The peeling test is not reliable as some of our deadly poisonous mushrooms, Destroying Angel, will peel as readily as the white mushroom, which is edible. The silver test is also unreliable, as the tarnishing of silver indicates only that the mushroom is old and begun to decay. Care must be taken to observe the characteristics of each mushroom gathered and to compare them with those of known poisonous kinds.

The following rules, if carefully followed, will enable one to avoid the poisonous forms:

- (1) Avoid fungi when in the button stage, especially if the button is enclosed in an envelope or sack; also avoid those in which the flesh has begun to decay, even if but slightly, and those that contain larvae or "worms" or "worm" holes.
- (2) Avoid all fungi which have stalks with a swollen base surrounded by a sac-like or scaly envelope, especially if the gills are white.
- (3) Avoid fungi having a milky juice, unless the milk is reddish.
- (4) Avoid fungi in which the cap is thin and very brittle, and in which the gills are nearly all of equal length, especially if the cap is bright coloured.
- (5) Avoid all tube-bearing fungi in which the flesh changes colour when cut or broken, or where the mouths of the tubes are reddish, and in the case of other tube-bearing fungi experiment with caution.
- (6) Avoid all mushrooms which have a bitter or unpleasant taste or unpleasant odour.
- (7) Avoid all mushrooms which are distinctly acrid or biting.
- (8) In case of doubt discard the plant.

The foregoing rules are given as a warning against comparatively few plants. These are as follows:

Deadly Poisonous Mushrooms:

Destroying Angel (*Amanita verna*)

Deadly Agaric (*Amanita phalloides*)

Fly Agaric (*Amanita muscaria*)

Frost's Agaric (*Amanita frostiana*), and other species of the same genus.

False Morel (*Gyromytra esculenta*)

Violently Poisonous:

Bitter Boletus (*Boletus felleus*)

Lurid Boletus (*Boletus luridus*)

Pepper Boletus (*Boletus piperatus*)

Satan's Mushroom (*Boletus satanus*)

Jack O'Lantern (*Clitocybe illudens*)

Scarlet Cap (*Russula emetica*)

Green Cap (*Russula virescens*)

Poisonous or Very Unpleasant:

Slimy Mushroom (*Cortinarius coerulescens*)

Large Entoloma (*Entoloma grande*)

Stinking Entoloma (*Entoloma graveolens*)

Pepper Mushroom (*Lactarius piperatus*)

Shaggy Lactarius (*Lactarius torminosus*)

Butterfly Mushroom (*Panaeolus papilionaceus*)

Frilled Stinkhorn (*Dictyophora duplicata*)

Common Stinkhorn (*Phallus impudicus*), and other Stinkhorns.

MUSHROOMS WHICH MAY BE GATHERED

The edible mushrooms are more numerous and include the following list:

All the puff balls, *Lycoperdon giganteum*, *L. craniformis*, etc.

All the coral fungi, *Clavaria* sp.

All the hedge hog or spiny fungi, *Hydnum* sp.

The true morels, *Morchella esculenta*, *M. angusticeps*, *M. crassipes*.

The fall morel, *Helvella crispa*.

All the mushrooms whose gills turn brown, *Agaricus campestris*, *A. placomyces*, *Pholiota dura*, *P. praecox*.

Mushrooms having a red or orange juice, *Lactarius deliciosus*.

All mushrooms that melt down into an inky liquid, *Coprinus comatus*, *C. atramentarius*, *C. micaceus*.

Many mushrooms with white gills, but one must be absolutely certain that they do not have a volva or poison cup.

White Mushroom (*Lepiota naucina*)

Parasol Mushroom (*Lepiota procera*)

Rooted Mushroom (*Collybia radicata*)

Velvet Stem (*Collybia velutipes*)

Oyster Mushrooms (*Pleurotus ulmarius*, *P. ostreatus*)

FOOD VALUE OF MUSHROOMS

The food value of mushrooms is not as great as that of many of our staple foods such as meat, wheat-flour, or beans, but it is about equivalent to that of our fresh vegetables. In addition, they give distinct and pleasing flavours to other food, and by furnishing the needed variety to our diet they become valuable as food accessories also. Further, if one knows wild mushrooms this extra food and luxury may be had at the expense of a few minutes' walk on a cool morning, or a trip to the woods or parks on a holiday.

During the past year numerous articles have appeared in newspapers and elsewhere advocating the use of wild mushrooms for food. From these articles one might be led to suppose that they had a very high food value, *i.e.*, "twice that of fresh vegetables or half that of lean meat." A careful examination of the chemical analyses of many species shows that mushrooms vary considerably in composition but in general are 90 per cent. water and 10 per cent. solid matter. In fact their composition resembles very closely that of turnips or cabbage. They are not "animal-like" in their nature as one might suppose from the popular statement that mushrooms are "vegetable beefsteak." A glance at the following table will show the food value of some common kinds compared with some of our staple foods:

NUTRITIVE VALUE OF TEN POUNDS OF SEVERAL FOODS*

	Proteids	Fats	Carbo- hydrates	Calories
a. Beef (round).....	1.87	.88	.....	7,200
Beans (dried)	2.23	.18	5.91	15,900
b. Cabbage	.18	.03	.49	1,400
Potatoes	.18	.01	1.53	3,250
Flour (roller process).....	1.13	.11	7.46	16,450
c. Shaggy Mane.....	.04	.025	.434	987
(<i>Coprinus comatus</i>)				
Oyster Agaric	.051	.042	.828	1,811
(<i>Pleurotus ostreatus</i>)				
Morel	.094	.05	.306	955
(<i>Morchella esculenta</i>)				
Common Cultivated Mushroom	.18	.03	.46	1,316
(<i>Agaricus campestris</i>)				
Oysters	.61	.14	.33	2,350

*Atkinson, Geo. F.—Mushrooms, Edible, Poisonous, Etc.

In the past the claim for the high food value of mushrooms has been based on the relatively large amount of nitrogen present, as this was taken as an indication of the presence of proportionally large amount of proteids, the characteristic substance in lean meat. Careful analysis of the mushroom substance has shown that a large part of this nitrogen containing substance is insoluble in gastric juice, *i.e.*, is indigestible. The reason for

this seems to be that some of the nitrogen enters into the formation of fungous cellulose which has the composition $C_6 H_{11} O_5 N H_2$, and resembles horn, hair and chitin, and consequently cannot be considered of any value as food.

TO KNOW WILD MUSHROOMS

There are in Ontario at least 150 kinds of fleshy fungi, which are large enough to attract the attention of a person collecting mushrooms for table use. However, not all of these can be used, as some of them are poisonous. Four of these are deadly poisonous and a few are reputed mildly poisonous and a few, which occur only occasionally, have unknown properties.

When one is gathering mushrooms one of the first questions he is asked is, "How do you tell mushrooms from toadstools?" This question implies that the inquirer thinks of mushrooms as edible and "toadstools" as poisonous. This question may be answered by saying that mushrooms and toadstools are the same. There is no sharp line of distinction, and no simple test which can be applied to distinguish the edible from poisonous forms. The so-called peeling test is useless, as one of our most poisonous forms peels as readily as the cultivated mushroom. The blackening of silver was at one time supposed to show that mushrooms were poisonous, but this test is of no value, as the blackening of silver only indicates the presence of sulphur or its compounds, and has no relation to poisons present. Some people say, "Collect only those mushrooms which grow in fields and pastures." Unfortunately, our deadly poisonous mushrooms, although generally growing in the woods, sometimes grow in lawns and pastures. On the other hand, if one does not gather mushrooms in the woods and parks many of the very best kinds will be missed.

The only way to be sure that mushrooms gathered are wholesome is to learn to know the mushrooms from their characters the same as we learn to know other plants. When one goes out to gather berries he must distinguish between nightshade and strawberries or between elderberries and spikenard. He comes to know the edible ones and to recognize those that are not edible, and leaves the latter alone. In the same manner one must learn to distinguish the mushrooms. This may be done by going out with someone who is familiar with mushrooms and has gathered them for use many times, or one may learn to know mushrooms by gathering the different kinds and carefully comparing them with descriptions and pictures. This method is, perhaps, the one which many will have to use.

There is still another way to learn mushrooms. The Department of Botany of this College will be very glad to identify any mushrooms sent in for this purpose. In order to have them identified they should be prepared as follows:

Carefully dig up the mushrooms so that all the fruit body, including the very base of the stalk, is present. Wrap in dry paper, taking care not to crush the specimens. A note should be attached which describes where the plants grew, whether in fields, or woods, or on the roadside. Whether they grew in the ground or on wood, and finally the colour of the plant in a fresh condition. They should then be enclosed in a strong cardboard box or tin can to protect them from being crushed, and addressed to

DEPARTMENT OF BOTANY, ONTARIO AGRICULTURAL COLLEGE, GUELPH, ONT.

KEY TO THE MUSHROOMS DESCRIBED IN THIS BULLETIN

The term mushroom is used to include all large fleshy fungi, whether edible or poisonous. The term toadstool is not used as it includes the same group of plants.

Fruit body umbrella shaped.	Page
1. With gills—True Mushrooms (<i>Agaricaceæ</i>).....	12
2. With pores—Boletus (<i>Polyporaceæ</i>).....	40
Fruit body shelf-like or bracket-like.	
1. With gills—True Mushrooms (<i>Agaricaceæ</i>).....	12
2. With pores—Polypores (<i>Polyporaceæ</i>).....	40
Fruit body with a wrinkled or honey-comb-like head—	
Morels (<i>Helvellaceæ</i>).....	43
Fruit body horn-shaped and having a carrion-like odour—	
Stinkhorns (<i>Phallaceæ</i>).....	46
Fruit body ball-like—Puff Balls (<i>Lycoperdaceæ</i>).....	48
Fruit body much branched.	
1. Branches growing upright—Coral Fungi (<i>Clavariaceæ</i>)..	51
2. Branches growing downward—Hedgehog fungi	
(<i>Hydnaceæ</i>).....	52
Fruit body cup-shaped or saucer-shaped—Cup Fungi (<i>Pezizaceæ</i>)	53

AGARICACEÆ (True Mushrooms)

In this group of fungi the fruit body is umbrella-shaped or shelf-like. On the under side of the cap are many thin plates, gills or lamellæ, which are packed closely together, side by side. The gills may be white or pink, or brown or black.

I. Gills white and remaining white.	Page
A. With a distinct stalk or stripe in centre of cap.	
1. Both volva and annulus present— <i>Amanita</i>	14
2. Volva present, annulus absent— <i>Amanitopsis</i>	20
3. Annulus present, volva absent.	
a. Gills free from the stalk— <i>Lepiota</i>	18
b. Gills attached to the stalk— <i>Armillaria</i>	22

	Page
4. Neither volva nor annulus present.	
a. Plants with a milky juice— <i>Lactarius</i>	26
b. Plants without a milky juice.	
*Flesh very brittle and somewhat granular or mealy, generally bright coloured— <i>Russula</i>	25
**Flesh firm, fleshy or fibrous.	
†Stalk fibrous, plants medium-sized to large, never very small.	
‡Gills notched at the stalk— <i>Tricholoma</i>	22
‡‡Gills running down the stalk.	
§Gills thin— <i>Clitocybe</i>	23
§§Gills thick and blunt— <i>Cantharellus</i>	24
††Stalk brittle or cartilaginous.	
‡Plants large— <i>Collybia</i>	25
‡‡Plants small— <i>Mycena</i> and <i>Omphalia</i> .	
(Not described in this Bulletin)	
†††Stalk tough, plants leathery when dry— <i>Marasmius</i>	27
(Only one described).	
B. Without a distinct stalk or a stalk at one side of the cap.	
1. Cap thick and fleshy— <i>Pleurotus</i>	28
2. Cap fleshy at first, but becoming corky or leathery.	
a. Gills toothed on the edge— <i>Lentinus</i>	29
b. Gills smooth on the edge— <i>Panus</i> (not edible).	
c. Gills split on the edge— <i>Schizophyllum</i> (not edible).	
3. Caps corky from the first— <i>Lenzites</i> (not edible).	
II. Gills at first white, but becoming pink or flesh coloured.	
A. Stalk central.	
1. With a volva— <i>Volvaria</i>	29
2. Without volva or annulus.	
†Stalk easily separated from the cap— <i>Pluteus</i>	30
††Stalk not easily separated from the cap.	
‡Gills notched at the stalk— <i>Entoloma</i>	31
‡‡Gills running down on the stalk— <i>Clitopilus</i> .	
(Not described).	
B. Stalk, none or attached to one side— <i>Claudopus</i> . (Not described.)	
(Some too small to be of any value are omitted.)	
III. Gills at first white or pink, but becoming yellowish brown or rusty brown.	
A. Stalk central.	
1. Veil cobwebby— <i>Cortinarius</i>	31
2. Veil forming a distinct ring— <i>Pholiota</i>	33
3. Veil and ring absent—(no good species).	
B. Stalk absent or attached to the side— <i>Crepidotus</i>	34

IV. Gills at first pink, becoming dark brown in age.

A. Stalk with a distinct ring.

1. Stalk easily separating from the cap, gills free—*Agaricus*..... 34
2. Stalk not easily separating from the cap, gills attached to the stalk—*Stropharia* 36

- ##### B. Stalk without a distinct ring, veil hanging in fragments from the edge of the cap—*Hyphaloma*..... 36

V. Gills white or pink at first, then becoming black.

- ##### A. Cap decomposing to form an inky liquid—*Coprinus*..... 37

- ##### B. Cap not decomposing to form an inky liquid—*Paneolus*..... 39

VI. Gills of various bright colours, red, yellow, purple, etc.

A. Gills lilac to purple.

1. Without a veil, gills notched—*Tricholoma*..... 22
2. With a cobwebby veil—*Cortinarius* 31

B. Gills yellow or orange.

1. Plants with milky juice—*Lactarius* 26
2. Plants without milky juice.
 - a. Gills thick and blunt—*Cantharellus*..... 24
 - b. Gills thin and sharp—*Clitocybe*..... 23

AMANTIA (Mostly Poisonous Mushrooms)

This genus contains the deadly poisonous mushrooms so one should become thoroughly familiar with it. These mushrooms possess both the ring or annulus and the poison cup or volva. When very young the cap is enclosed in a sack, and as the mushroom enlarges the sack is broken so that part of it remains in the ground as a cup at the base of the stalk while the upper part may form loose scales on the top of the cap. The gills are at first hidden by a curtain or veil, which stretches across the space between the edge of the cap and the stalk. When the cap opens out the veil is torn away from the margin of the cap and forms a ring on the stalk. The gills are white at first and remain white, never becoming pink, or yellow, or brown or black.

There are several species of *Amanita*, nearly all of which are deadly poisonous. There are a few species of *Amanita* which are edible but it would be very unwise for any one, except an expert, to eat them. It is far better to let all species of *Amanita* alone rather than take even the slightest risk.

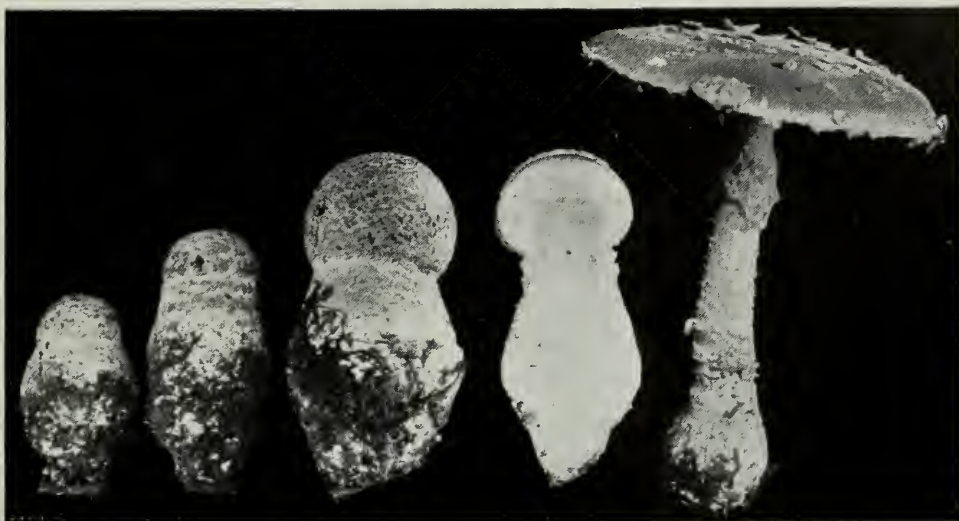


FIG. 3.—Fly Agaric. Original. Note the volva or poison cup and the loose scales on the cap.

FLY AGARIC (*Amanita muscaria*, Linn.). DEADLY POISONOUS. (Fig. 3.)

This fungus appears in July and August in groves and open woods or along roadsides near trees, usually preferring rather poor soil. It is called “Fly Agaric”, because an infusion of the plant was at one time used as a fly poison. The plant is typically large and handsome.

The cap is 3 to 5 inches broad, rounded when young, nearly flat when old, yellow or orange or even bright red in colour, and covered with numerous angular scales, which are white or light yellow in colour, and can easily be brushed off. As the cap becomes old it fades out, so that it may become nearly white and the scales may be washed off by rains.

The stalk is 4 to 6 inches long, about one-half inch thick, usually white, but often yellowish in colour, hollow in age. The bottom of the stalk is set in a shallow poison cup, or volva, but this is sometimes hard to distinguish and appears more like a shaggy or scaly bulb. The lower part of the stalk above the poison cup may also be shaggy or scaly.

The gills are white or slightly tinged with yellow, and do not become pink or brown as do those of many edible mushrooms.

The ring is quite large, white, and firmly attached to the stalk.

The main points to remember about this fungus are:—The yellow or orange cap with loose white scales. Gills white, never becoming pink or brown. Ring large, white, firmly attached to the stalk. The stalk inserted in a shallow poison cup or enlarged at the base into a prominent shaggy or scaly bulb and the stalk shaggy below the ring.

The poison in this mushroom is known as muscarin, and is found all through the fruit body and not confined to the poison cup or volva. This substance, fortunately, has an unpleasant bitter taste, so that the plant is seldom eaten even if collected by mistake. The poison does not act im-

mediately, but the symptoms appear in from one-half to two hours, and are: vomiting and diarrhoea, with a pronounced flow of saliva, suppression of urine, giddiness, uncertainty of movement, derangement of vision. This is followed by stupor, cold sweats and weakening of the heart action.

Of course when symptoms such as these appear after eating mushrooms a physician should be sent for immediately.

The system should be freed of the undigested fungus as soon as possible. Strong emetics, such as zinc sulphate, apomorphine or warm mustard and water should be used. If these are lacking or produce no effect, tickle the throat with a feather or the finger to cause immediate and violent vomiting. This should be followed by a strong dose of castor oil.



FIG. 4.—Frost's Agaric.
Original.



FIG. 5.—Deadly Agaric. Half Natural Size
(Original).

FROST'S AGARIC (*Amanita frostiana*, Pk.). (Fig. 4.)

This is much like the Fly Agaric, except it is somewhat smaller. It often accompanies the Fly Agaric but usually grows in denser woods. The mushroom is 2 to 3 inches high and the cap from 2 to 2½ inches broad.

THE DEADLY AGARIC (*Amanita phalloides*, Fr.). DEADLY POISONOUS.
(Fig. 5.)

This fungus is called the Deadly Agaric because it is extremely poisonous, and there is no known antidote for the poison.

The plant usually grows in the woods or along the borders of woods, but has also been known to appear in lawns. It generally appears in July

and August. It is quite variable in colour, varying from pure white through yellowish to olive. Some place the white forms in a different species.

The cap is 1.5 to 4 inches broad, at first bell shaped, finally nearly flat, fleshy, viscid or slimy when fresh, smooth, often with a few loose white scales. The colour varies from white through yellow to olive green, the dark forms being more common in Ontario.

The stalk is 2 to 8 inches long, one-quarter to one-half an inch thick, hollow, white, or coloured like the cap, but lighter in shade, becoming discoloured on handling. It ends in an abrupt bulb which generally has a sharp rim standing up around it, forming a sort of cup, called poison cup or volva. This poison cup is usually deeply buried in the soil, so that in order to find it, it is necessary to dig the plant up.

Gills white and remain white, never becoming pink or brown.

The ring is white, prominent, and is high up on the stalk close to the cap. The ring is attached to the stalk, not loose as in the smooth white mushroom or parasol mushroom.

The poison in the Deadly Agaric is phallin, and is found all through the mushroom and not confined to the poison cup or volva. This poison, unfortunately, has no pronounced taste or odour, and gives no warning of its presence. Unfortunately, also, the symptoms of poisoning do not manifest themselves until nine to fourteen hours after the fungus is eaten. There is then considerable abdominal pain, and there may be cramps in the legs accompanied by convulsions and even lock-jaw and other tetanic spasms. The pulse is weak and abdominal pain is rapidly followed by vomiting and extreme diarrhoea, the intestinal discharges assuming the rice-water condition characteristic of cholera. These later symptoms persist, generally without loss of consciousness, until death ensues, which happens in from two to four days.

There is no known antidote for phallin. The undigested portions of the fungus should be removed from the stomach and intestines by methods similar to those suggested under the Fly Agaric. If the poison already absorbed is not too great, it may wear itself out and the patient recover.

Of course when symptoms of poisoning appear a physician should be sent for immediately.

THE DESTROYING ANGEL (*Amanita verna*, Bull.). DEADLY POISONOUS. (Fig. 6.)

This fungus is probably the cause of more cases of mushroom poisoning than any other.

The plant is pretty, clean, pure white and attractive.

It usually occurs in the woods or near them, but may grow in lawns newly made from forest soil. It is generally found in June and July.

The cap is 1.5 to 4 inches in diameter, at first bell shaped, later becoming nearly flat; *pure white, shining, viscid or slimy when fresh.*

The stalk is 2 to 6 inches long, one-quarter to one-half inch thick, pure white, hollow in age. The stalk ends in an abrupt *bulb*, with a free border closely surrounding the base of the stalk and forming the poison cup or volva. This may be seen in even young specimens as shown by Fig. 6. This poison cup is buried in the soil, so that in order to see it, it is usually necessary to dig the plant up. For this reason wild mushrooms growing in the soil should always be dug, not pulled up or broken off.

The gills are pure white and remain white, never becoming pink or brown.

The ring is broad and high up on the stalk, just under the cap. It is firmly attached to the stalk, and is not loose, as in the smooth, white mushroom.

Since this is our most poisonous mushroom its main characters should be thoroughly learned and remembered.

The cap is pure white, shining and slimy when fresh. The stalk is pure white, ending in a distinct poison cup of volva. Gills pure white and remain white. Ring white, broad, high upon the stalk to which it is firmly attached.

The poison in this fungus is the same as that in the Deadly Agaric, and the symptoms of poisoning and treatment are the same.



FIG. 6.—Destroying Angel. Original. Note particularly the volva or poison cup.

LEPIOTA

In this genus the gills are white and free from the stalk, there is a prominent ring which is often moveable, *i.e.*, it can be slipped up and down on the stalk; but there is no poison cup or volva. The plants are edible but care must be taken to distinguish them from Amanitae. There are three common species.

PARASOL MUSHROOM (*Lepiota procera*, Scop.). EDIBLE (Fig. 7.)

This is one of our striking mushrooms, and is not inappropriately named. It grows in pastures, lawns, gardens, along roadsides, and in open woods in late summer and early autumn.

The cap is at first bell shaped, later becoming parasol shaped. It is 2 to 6 inches in diameter, at first greyish or brownish red, but as the cap expands the coloured surface breaks up into scales, showing the white flesh underneath. Finally the cap becomes shaggy in appearance.

The stalk is 4 to 8 inches long, one-sixth to one-quarter of an inch in diameter, the same colour as the cap, and generally becomes hollow in age.

The gills are white, free from the stem, and closely crowded.

The ring is stout, narrow, and usually quite free from the stem, so that it may be moved up and down.

WHITE MUSHROOM OR SMOOTH MUSHROOM (*Lepiota naucina*, Fr.). EDIBLE.
(Fig. 8.)

This mushroom grows in lawns, pastures and along roadsides, and is most abundant in September and early in October. The plant is entirely white or in old specimens somewhat buff.

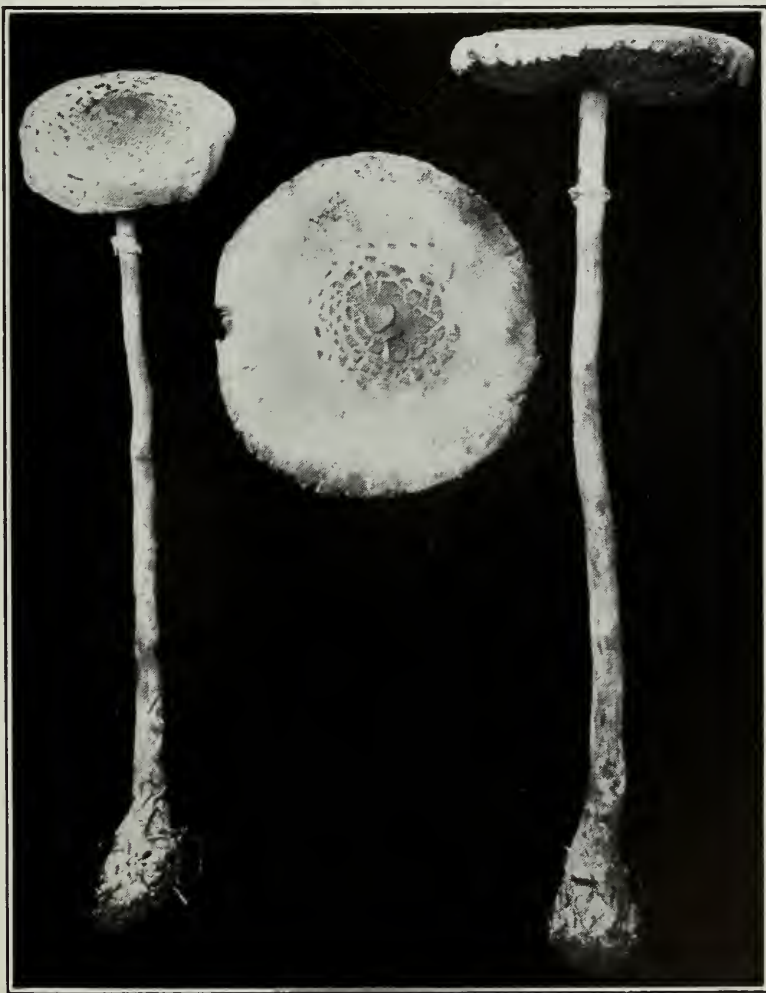


FIG. 7.—Parasol Mushroom (Original).



FIG. 8.—White Mushroom. Original. Note the absence of the volva or poison cup even in young stage.

The cap is 2 to 4 inches broad, globose to hemispheric, entirely white or slightly tinged with buff, and smooth. The stalk is $1\frac{1}{2}$ to 3 inches long, one-third to one-half an inch thick, often hollow, white and generally with a *smooth* bulb at the base. The gills are free from the stalk, white or a dirty pink in old specimens.

The veil at first hides the gills, later the veil breaks away from the edge of the cap and forms a ring on the stalk. The ring often fits loosely to the stalk and may be slipped up and down.

CAUTION. Although this mushroom is very good, care must be taken to distinguish it from some deadly poisonous plants which sometimes grow in the same situations. The white mushroom described here, although white is not shiny, is dry, not slimy or viscid, and has a smooth bulb at the base of the stalk, not a shaggy bulb or cup.

CRESTED MUSHROOM (*Lepiota cristata*, A. & S.). EDIBLE. (Fig. 9.)

This is a very pretty little mushroom growing in lawns and on roadsides. It is from $1\frac{1}{2}$ inches to 2 inches high and the cap is from one-half inch to $1\frac{1}{2}$ inches broad. The top of the cap is ornamented with numerous fine reddish brown scales on a white background, the centre of the cap usually has a small reddish brown central spot. The gills are white. The stem is slender, white and bears a small white ring.

AMANITOPSIS

This genus is much like *Amanita* except there is no ring. That is, the mushroom has a cap and stalk and volva or poison cup, but the ring on the

stalk is not formed. The species are said to be edible but they are so easy to mistake for species of *Amanita* that it is best to leave them alone.

SHEATHED AGARIC (*Amanitopsis vaginata* (Bull.), Roz.). (Fig. 10.)

The Sheathed Agaric is widely distributed in woods. The plant is from 2½ to 6 inches high and the cap 1½ to 3 inches broad. The cap is somewhat bell shaped with fine ridges on the margin. It varies in colour from nearly white through grey to light brown. The gills are white. The stalk is slender and white. There is *no ring*. At the base of the stalk there is a white volva or poison cup which forms a close fitting sheath around the base of the stalk.

This mushroom is edible but it so closely resembles the Deadly Agaric (*Amanita phalloides*) that it is best to leave it alone.



FIG. 9.—Crested Mushroom. Original.



FIG. 10.—Sheathed Mushroom. Original.
Note the absence of a ring.



FIG. 11.—Honey Agaric. Original.



FIG. 12.—Blue Hat or Bluet. Original.

HONEY AGARIC (*Armillaria mellea*, Vahl.). EDIBLE. (Fig. 11.)

This mushroom grows on rotting wood and may be found on logs or at the base of trees, generally in clusters of three or four to as many as a dozen or more.

The plant varies in size, generally 4 to 6 inches high and the cap 2 to 4 inches broad.

The cap is light yellow or honey coloured. The gills white, and firmly attached to the stalk. The stalk is white and generally fibrous or stringy. There is a soft, white ring on the stalk which is easily destroyed and often not seen. There is no volva or poison cup.

This mushroom is edible but not of good flavour unless taken when very young. It is hardly worth collecting.

TRICHOLOMA

In this genus are placed all mushrooms having white spores, but which have no ring or volva and the gills notched at the stalk. The plants are all fleshy but firm. The gills are mostly white but one species has gills which are lilac to light purple.

BLUE HAT OR BLUET (*Tricholoma personatum*, Fr.). EDIBLE. (Fig. 12.)

This mushroom is very pretty. The cap and stalk are lilac or light purple when young but fade to nearly white when old.

The cap is from 2 to 3 inches broad, thick and fleshy. Gills lilac in colour and notched at the stalk. The stalk is short, thick, solid and generally swollen or bulbous at the base. There is no poison cup, *i.e.*, volva, or ring.

WHITE HAT OR WHITE TRICHOLOMA (*Tricholoma album*).

This mushroom is about the same shape and size as the preceding, but is pure white. It is edible but not especially desirable.

SULPHUR HAT (*Tricholoma sulphureum*, Bull.). POISONOUS.

This mushroom is sulphur yellow in colour. The cap is 1 to 3 inches broad, thick and fleshy. The gills yellowish and notched at the stalk. The stalk is 2 to 4 inches long, firm, and bulbous at the base, sulphur yellow. There is no ring or poison cup.

The plant has a strong, disagreeable odour. It grows in the woods on old leaves and on rotting logs. The plant resembles the blue hat but is sulphur yellow instead of blue.

CLITOCYBE

These mushrooms are generally funnel shaped or top shaped with the gills running down the stalk. There is no ring or poison cup. Gills are white, but in a few cases yellow. The plants are firm, fleshy or fibrous.

TUFTED MUSHROOMS (*Clitocybe multiceps*, Pk.). EDIBLE. (Fig. 13.)

This mushroom grows in dense clusters in well manured grass land.

The caps are white or light grey, top shaped and there may be as many as a dozen in a cluster. The caps are 1½ to 3 inches across and very firm and fleshy. The stalk is white and firm and the gills run down the stalk. There is no ring and no poison cup or volva.



FIG. 13.—Clustered Mushroom.
Original.



FIG. 14.—Jack O'Lantern. Original.



FIG. 15—Chantarelle (After Thaxter.)



FIG. 16.—Rooted Mushroom.
Original.

TUFTED HONEY TOP (*Clitocybe monadelphpha*, Morg.) **EDIBLE.**

This mushroom also grows in dense clusters but is usually found at the base of stumps. The caps are light yellow or honey coloured. It can easily be mistaken for the Honey Agaric but the tufted honey top lacks a ring and is not so fibrous. The plant is edible but it generally has a woody flavour.

JACK O'LANTERN (*Clitocybe illudens*, Schw.). **POISONOUS.** (Fig. 14.)

This mushroom is yellow to saffron in colour and occurs in clusters on decaying wood. The caps are more or less funnel shaped and 4 to 6 inches broad. The gills are yellow and extend down the stem for a considerable distance. The whole plant is phosphorescent and in a dark room is surrounded with a distinctly ghostly glow. For this reason it is often called Jack O'Lantern, or Fox Fire. The plant is a violent emetic and should be avoided.

CANTHARELLUS

These mushrooms are funnel shaped and the gills extend downward on the stalk. The gills are thick and blunt, often branched, not thin and plate-like as in most other mushrooms.

CHANTARELLE (*Cantharellus aurantiacus*, Fr.). **EDIBLE.** (Fig. 15.)

This mushroom is funnel shaped and a deep yellow in colour. The gills are branched and low and blunt. It can be distinguished from the Jack O'Lantern by its low, branched gills, and the firm fleshy character of the stalk, which is never fibrous, and the absence of the glow when put in the dark.

COLLYBIA

Many of these mushrooms are medium sized to large and very graceful in appearance. The gills are white or slightly tinged with yellow. The stalks are slender and very brittle or cartilaginous.

ROOTED MUSHROOM (*Collybia radicata*, Rehl.) EDIBLE. (Fig. 16.)

This is a very common mushroom around stumps. The cap is smoky grey and somewhat sticky when moist. It is 2 to 4 inches across. Gills pure white. The stalk is dark, smoky grey, slender and very brittle, 3 to 8 inches long. When the plant is pulled up a long tapering root-like portion remains attached to the stalk.

VELVET STEM (*Collybia velutipes*, Curtis.) EDIBLE. Fig. 17.)

This mushroom occurs on rotting wood in dense clusters of six to twenty or more. The caps are light yellow to dull yellow, slightly sticky when moist and 1 inch to 2 inches in diameter. The gills are white or light yellow. The stalk brown and velvety. It may be found on rotting wood from early spring to late fall.



FIG. 17.—Velvet Stem Mushroom. Original.



FIG. 18.—Scarlet Cap. Original.

RUSSULA (Coloured Mushrooms)

These mushrooms are mostly bright coloured, red, pink, green, sometimes white. There is no ring or poison cup, and the flesh is very brittle and mealy or porous in appearance. The flesh shows mingling of fine threads and little vessels. Many are reputed to be poisonous.

SCARLET CAP (*Russula emetica*, Fr.). REPUTED TO BE MILDLY POISONOUS. (Fig. 18.)

This fungus occurs very commonly in the woods from summer until autumn. It gets its name from the bright scarlet cap. It is hot and peppery

to the taste, and some report it to be mildly poisonous, while others say that it is edible.

The cap is 1.5 to 3 inches wide, thin, brittle, deep pink to rich red; furrowed near the edge, rounded when young, depressed in the centre when old.

The stalk is 2 to 3 inches long, white or tinged with yellow. Very brittle.

There is no ring and no volva or poison cup.

GREEN CAP (*Russula virescens*, Fr.). POISONOUS?

This mushroom resembles the preceding one but the cap is green. The plant is looked on with suspicion.

LACTARIUS (Milky Mushrooms)

These mushrooms are mostly funnel shaped and give out a milky juice when cut or broken. In some the milk is orange, some white, some white at first then becoming golden yellow; one has blue milk.

ORANGE FLOW (*Lactarius deliciosus* (L), Fr.). EDIBLE. (Fig. 19.)

This mushroom occurs abundantly in balsam and spruce woods in the autumn. When broken the flesh gives out an orange-coloured juice. The plants have a pleasing fruity odour.

The cap is 3 to 5 inches broad, funnel shaped, yellow or pale orange with bands of lighter colour; slightly hairy; juice or milk orange coloured.

The stalk is 2 to 3 inches long, about an inch thick, hollow and brittle. The gills are yellow or orange, running down on the stem.

There is no ring.



FIG. 19.—Orange Flow. Edible. Two-thirds Natural Size (Original).

SHAGGY LACTARIUS (*Lactarius torminosus*, Fr.). REPUTED TO BE POISONOUS.
(Fig. 20.)

This mushroom is common on the ground in the woods. The caps are funnel shaped, 2 inches to 5 inches in diameter; pink or reddish in colour, zoned or spotted with darker colour. The margin of the cap is shaggy with long hairs which often extend nearly to the centre of the cap. The milk is white or whitish, the plant does not have the pleasant fruity odour of the Orange Flow. The flesh and milk have a sharp acrid taste.

PEPPER MUSHROOM (*Lactarius piperatus*, Fr.).

Some authorities say this mushroom is edible while others state that it is poisonous.

The plant is pure white. The cap is funnel shaped, the gills extend well down on the stalk and exude a white milky juice when bruised. The juice is very acrid and causes an intense burning sensation when tasted. The stalk is short, thick, solid and also gives out a white milky juice when bruised.

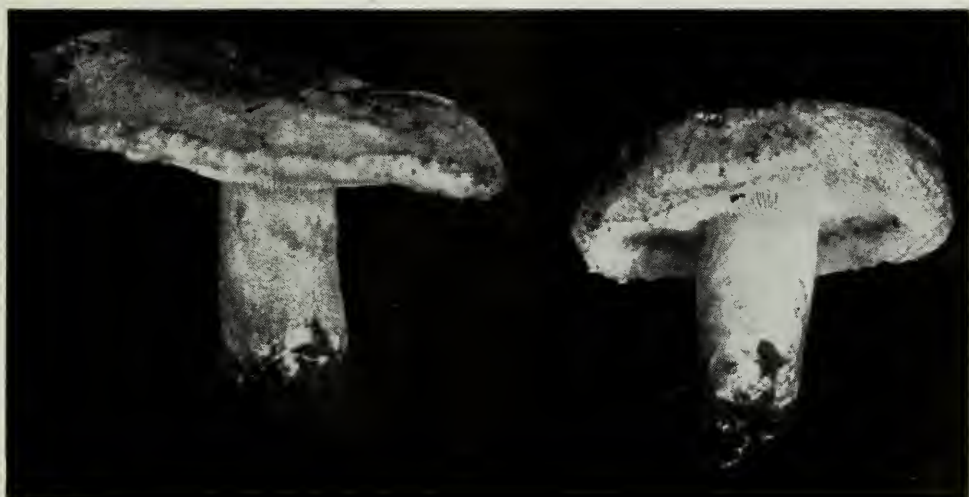


FIG. 20.—Shaggy Lactarius. Original.

MYCENA

These are very small and fragile mushrooms and not important.

OMPHALIA

These mushrooms are also small and unimportant.

MARASMIUS

These mushrooms are mostly too small and tough to be edible; one species, however, large enough to become valuable as a food plant.



FIG. 21.—Fairy Ring Mushroom. Original.

FAIRY RING MUSHROOM (*Marasmius oreades*, Fr.). EDIBLE. (Fig. 21.)

This mushroom grows in lawns and pastures forming distinct rings or parts of rings. The caps are white with a light brownish tinge and 1 to 2 inches in diameter; gills white; stem white and slightly hairy. When young the caps are tender but they become tough and leathery when they begin to dry up.

The caps may be dried easily and have the appearance and taste of fresh mushrooms when soaked in water.

PLEUROTUS (Oyster Mushrooms).

These mushrooms generally grow in dense clusters on logs and stumps; one species grows on elm exclusively. The caps are usually shell-like with no stalk or with the stalk at one side of the cap.



FIG. 22.—White Oyster Mushroom. Edible. Natural Size (Original).

ELM MUSHROOM (*Pleurotus ulmarius*, Bull.) EDIBLE.

This mushroom grows on elm logs and stumps and often develops from knot holes in elm trees. The caps are white or grey, large, 3 to 6 inches across and thick, solid and fleshy. Gills are white. There is no ring or poison cup. The stalk is generally near one side of the cap.

WHITE OYSTER MUSHROOM (*Pleurotus ostreatus*, Jacq.). EDIBLE. (Fig. 22.)

This mushroom is so named because the white, one-sided caps resemble, to some extent, oysters. The plant grows on dead logs and stumps in dense clusters, the caps overlapping each other. It occurs in late summer and autumn.

The cap is one sided, with a very short, solid stalk or none, 2 to 8 inches wide, white or greyish, thick and fleshy.

The stalk is at one side, short, thick, solid, or absent.

The gills are white, running down the stalk.

DARK OYSTER MUSHROOM (*Pleurotus serotinus*, Schrad.). EDIBLE.

This mushroom resembles the preceding one, but is darker in colour. It also grows on logs and stumps, either occurring singly or in small, overlapping clusters. It is common in damp woods in the autumn.

The cap is attached by one side, 2 to 5 inches wide, sometimes yellow, but more often greenish brown or with an olive tinge. The flesh under the "skin" or pellicle is white or whitish.

The stalk is very short or none.

The gills are white or with a yellowish tinge.

In cooking this mushroom it is best to remove the dark skin or pellicle, as it improves the appearance of the food, although it does not improve the flavour.

LENTINUS (Scaly Mushrooms). (Fig. 23.)

These mushrooms have large caps which are usually scaly. When young they are firm and fleshy, but become corky or woody when old. The gills are white and toothed or irregularly torn on the margin. They are mostly too tough to be edible but the Scaly Cap (*Lentinus lepideus*, Fr.) is good when very young.

MUSHROOMS WITH PINK GILLS

In this group of mushrooms the gills are at first white and then become pink or flesh coloured.

SILKY MUSHROOM (*Volvaria bombycina* (Pers.), Fr.). EDIBLE.

This mushroom is edible but care must be taken not to mistake the Deadly Agaric or Destroying Angel for it.



FIG. 23.—Scaly Mushroom. Original.



FIG. 24.—Fawn Cap. Original.

This mushroom has a large cap, 2 inches to 10 inches in diameter, all white and somewhat silky, usually bell-shaped. Stalk 3 to 4 inches long, white and smooth. The gills are first white then pink. At the base of the stalk there is a prominent bag, the poison cup or volva, but there is no ring.

The mushroom differs from the Deadly Agaric and the Destroying Angel, in that its gills become pink instead of remaining white. There is no ring in *Volvaria*, whereas it is present in the deadly poisonous mushrooms.

FAWN CAP (*Pluteus cervinus*, Schaeff.). EDIBLE. (Fig. 24.)

This is a large mushroom growing on rotten wood. The cap is 2 to 5 inches in diameter, brown to fawn colour, bell shaped at first then becoming nearly flat. The gills are first white, then become pink. They do not touch the stalk but are free from it. The stalk is 3 to 6 inches long and brownish in colour, often deeply buried in the rotten wood. The stalk can be easily separated from the cap to which it seems to be united by a ball and socket joint.

One of our best mushrooms.

ENTOLOMA

In these plants there is no ring or poison cup. The gills are at first white then become pink or salmon coloured. The gills are attached to the stalk but are usually notched.

LARGE ENTOLOMA (*Entoloma grande*, Pk.). POISONOUS

This mushroom has a cap 4 to 6 inches wide, white or brownish, smooth at the edge, but somewhat wrinkled near the central knob. The stalk is 4 to 6 inches long and white in colour. The gills are so deeply notched that they are almost free from the stalk. The stalk does not separate readily from the cap. The odour and taste are somewhat like meal, but leave a burning or biting feeling in the mouth. It grows on the ground in the woods. Care should be taken to distinguish this from the Fawn Cap (*Pluteus cervinus*).

STINKING ENTOLOMA (*Entoloma graveolens*, Pk.).

Probably not poisonous but has a very unpleasant odour. This mushroom may be white to brown with a purple or lilac tint, and resembles the Blue Hat or Bluet (*Tricholoma personatum*). It can be readily distinguished by its unpleasant fetid odour.

MUSHROOMS WITH RUSTY BROWN GILLS

In this group of mushrooms the gills are at first white or rusty, finally becoming yellowish brown or dark rusty brown.

CORTINARIUS

In these mushrooms there is no poison cup or ring and the gills become rusty brown. When the plants are young numerous fine threads connect the edge of the cap with the stalk, so that the gills are partially hidden by the cobwebby veil.

FALSE BLUE HAT OR FALSE BLUET (*Cortinarius violaceus*, Fr.) EDIBLE. (Fig. 25.)

The cap is 3 to 5 inches wide, dull to deep violet but fading to lilac when old. The stalk is 3 to 4 inches long, bulbous at base and solid. The gills are lilac at first then become rusty brown. They are notched at the stalk as in the Blue Hat but are at first partially hidden by a cobwebby veil. It grows on the ground in the woods.

SLIME CAPPED MUSHROOM (*Cortinarius coerulescens*, Fr.). POISONOUS? (Fig. 26.)

This is a slender mushroom with a cap 1 to 2 inches wide, slimy when fresh, and brown in colour. The stem is slender and the gills are hidden at first by the cobwebby veil. It is not a tempting looking plant. There are several slimy mushrooms, none worth gathering, and will seldom be collected.



FIG. 25.—False Bluet. Original.



FIG. 26.—Slimy Cap Mushroom. Original.



FIG. 27.—Early Mushroom. Original.



FIG. 28.—Hard or Cracked Mushroom. Original.

PHOLIOTA

These mushrooms have no poison cup but a ring is present on the stalk. The gills are attached to the stalk and become rusty brown or dark brown in colour.

EARLY MUSHROOM (*Pholiota praecox*, Pers.). EDIBLE. (Fig. 27.)

This mushroom appears usually in late spring or early summer. The cap is white to light tan colour and 1 inch to 2 inches in diameter; generally hemispherical. The stalk is slender, white and about 2 inches long. The ring is small and may be lost in old specimens. The gills are at first white, then brown. The plant grows in grassy places, lawns, roadsides, pastures.

CRACKED MUSHROOM OR HARD MUSHROOM (*Pholiota dura*, Bolt.). EDIBLE. (Fig. 28.)

This mushroom occurs in midsummer and can frequently be found in stubble fields or even in cultivated fields.

The caps are medium sized to larger, 2 inches to 4 inches in diameter, white or light yellow and usually cracked into irregular areas. The flesh is firm and thick. The stalk is white, about 3 inches long. There is a distinct ring on the stalk and often a ragged fringe on the edge of the cap. The gills become rusty brown.

This is one of our best mushrooms.



FIG. 29.—Scaly Mushroom. Original.

SCALY CAP (*Pholiota squarrosa*, Mull.). (Fig. 29.)

Edible but not very desirable. The caps only should be eaten.

This mushroom grows in clusters on wood, often at the foot of trees. The cap is yellow to rusty brown and covered with shaggy scales. The

cap is 3 to 5 inches in diameter, the stem is 4 to 8 inches long and is shaggy or scaly. There is a prominent ring on the stalk. The gills become rusty brown. The stalk is quite tough and the whole plant has a woody taste.

BROWN GILLED SHELF MUSHROOM (*Crepidotus mollis*, Schaeff.)

This mushroom resembles the oyster agaric but the gills are brown instead of white. Edible but not very good.

MUSHROOMS WITH DARK BROWN GILLS

These mushrooms have gills that are pink at first then turn a deep purple brown, almost black. The common cultivated mushroom belongs here. In most cases the "mushroom with pink gills" is one of these forms.

AGARICUS

These mushrooms have no "poison cup" or volva but there is a very conspicuous ring on the stalk. The stalk and cap can be easily separated. The gills are not attached to the stalk and are at first pink, then become dark brown.

COMMON MUSHROOM, CULTIVATED MUSHROOM (*Agaricus campestris*, Linn., or *Psalliota campestris*, (Linn.) Fr.). EDIBLE. (Fig. 1.)

This is the mushroom commonly cultivated. It also grows wild, and may be found in lawns, meadows, pastures, cultivated fields, greenhouses, and is very common on well-cared-for golf links. It may be found from late spring until fall, but is more abundant in summer and early autumn, when nights are cool and the days warm and not too dry.

The cap 2 to 4 inches wide, at first hemispherical, later becoming flat; white or with brown threads over the surface, giving a greyish or brownish silky appearance; flesh solid and white. The stalk or stipe is 2 to 4 inches long, one-half to three-quarters of an inch thick, firm, coloured like the cap. The gills are free from the stalk at the inner end; at first pink, later becoming purple brown or nearly black. The gills are at first hidden by the veil which later is torn apart, leaving a fringe on the edge of the cap and a small ring on the stalk.

FIELD MUSHROOM OR HORSE MUSHROOM (*Agaricus arvensis*, Schaeff., or *Psalliota arvensis*, (Schaeff.) Fr.). EDIBLE.

Grows in fields and meadows.

This is very much like the common mushroom, except that the stalk is longer and becomes hollow in age and the veil is thicker, so that the ring or annulus may appear double. The gills are at first pink, then turning brown. Some spawn companies claim to have the "spawn" of this species for sale.

SCALY OR FOREST MUSHROOM (*Agaricus placomyces*, Pk.). EDIBLE.
(Fig. 31.)

This mushroom grows in woods or borders of woods, coming up from the fallen leaves. It most frequently occurs where there are some hemlock or pine trees. It may be found from June to September.

The cap is 2 to 5 inches in diameter, at first rounded, finally nearly flat, but thicker in the centre. It is first brown, but as the cap expands the brown surface breaks up into numerous small scales exposing the white flesh below. The stalk is 2 to 5 inches long, one-quarter to one-third of an inch in diameter, white, slightly bulbous at the lower end, often becoming hollow. The gills are free from the stalk, at first white, but very soon becoming pink and finally dark brown. The veil is thick, so that a large prominent ring is formed which sometimes appears double.

RODMAN'S MUSHROOM (*Agaricus rodmani*, Pk.). EDIBLE.

This mushroom occurs very commonly in cities and towns, on lawns and boulevards. The plant is entirely white with tinges of yellow. It is about the same size as the common mushroom, but the stalk is very short and solid. The veil is quite thick and forms a distinct double ring or annulus. The gills are at first pink, then dark brown. Some seed companies claim to have the "spawn" of this species for sale.



FIG. 30.—Scaly or Forest Mushroom. Edible. Natural Size (Original).

DUNG MUSHROOM (*Stropharia stercoraria*, Fr.). (Fig. 31.)

Edible but hardly desirable.

This little mushroom occurs frequently on dung. The plant is from 2 to 3 inches tall with a very slender stalk which is yellowish in colour. The cap about one inch broad, yellow to light brown. The gills are at first pink then dark brown and are attached to the stalk. There is a small ring on the stalk but no volva or poison cup.



FIG. 31.—Dung Mushroom. Original.

HYPHOLOMA

The plants in this genus all have purple gills, which are attached to the stalk. The veil generally breaks away from the stalk and hangs as a fringe from the edge of the cap. The ring is inconspicuous or absent. There is no volva or poison cup.

BRICK RED MUSHROOM (*Hypholoma sublateritium*, Schaeff.)

Edible, but sometimes bitter.

This mushroom grows in dense clusters on old stumps, often appearing on the ground where the fungus is growing on buried pieces of wood.

The caps are brick red in colour, often brighter coloured on the margin, and 2 to 3 inches broad. The stalks are slender, often curved. The gills are nearly white at first, then become dull yellow and finally purple brown, often mottled. The gills are at first hidden by a veil which breaks away from the stalk and then hangs as a ragged curtain from the margin of the cap. The ring is inconspicuous.

BROWN MUSHROOM (*Hypholoma appendiculatum*, Bull.). EDIBLE.
(Fig. 32.)

This mushroom looks much like the preceding one but the mushrooms often grow singly as well as in dense clusters. The caps are thin and brown.

BLACK GILLED MUSHROOMS

In this group of mushrooms the gills become black when the plants become mature, although they may be pink or even white in young stages. The most conspicuous plants of this group melt down into an inky liquid when they become mature.

COPRINUS

This genus is characterized by the melting down of the plant to form an inky liquid at maturity.



FIG. 32.—Brown Mushroom. Original.



FIG. 33.—Shaggy Mane. Original.

SHAGGY MANE (*Coprinus comatus*, Fr.). EDIBLE. (Fig. 33.)

The Shaggy Mane is one of the most prized mushrooms by those who know it. The plant is quite large and distinguished by its shaggy cap, which melts down, forming inky liquid as the plants become old. It occurs in lawns and other grassy places, especially in richly-manured ground. The plants sometimes occur singly or a few together, but often quite large numbers of them appear in a small area. They occur most abundantly during quite wet weather, or after heavy rains, in late spring or early autumn, sometimes in summer.

The cap is cylindrical, usually brownish at first, but the surface becomes broken up, forming shaggy scales and exposing the white flesh underneath. The cap is 4 to 7 inches long, 2 inches thick. As the plant becomes old the cap melts down into an inky liquid and wastes away.

The stalk is white, 6 to 9 inches long, thickened at the base and hollow.

The gills are at first white, then pink, changing to brown, finally becoming black and melting down into an inky liquid.

There is a ring in young specimens, but this usually disappears.

Since the cap and gills turn into an inky liquid the plants should be gathered early in the morning before the cap and gills have begun to change colour or when the gills near the edge are flesh colour. It may also be eaten after the gills become black, but the inky looking mass is not inviting.



FIG. 34.—Ink Cap. Original.

INK CAP (*Coprinus atramentarius* (Bull.), Fr.). EDIBLE. (Fig. 34.)

The Ink Cap occurs in much the same places as the Shaggy Mane and is sometimes found accompanying it, but is usually more common and abundant. Sometimes the plants are scattered, but usually there are ten or twenty in a dense cluster.

The cap is egg-shaped or oval, generally smooth or somewhat scaly, 2 to 3 inches long, silvery grey, or ashen grey, or smoky brown. At maturity the cap melts down into an inky liquid.

The stalk is 3 to 4 inches long, one-half inch thick, hollow, the same colour as the cap, or in some a little lighter in colour. There is no distinct ring, but an irregular raised ridge about the stalk at the bottom of the cap.

The gills are packed very close together; at first whitish, soon becoming pink, then moist and black, and dropping away as an inky liquid.

Like the Shaggy Mane, this mushroom must be gathered early if one is to enjoy it, as on warm days the cap may be entirely gone by noon, but if they are gathered early and kept in a cool, dry place, they may be preserved for a few hours.

MICA CAP (*Coprinus micaceus* (Bull.), Fr.). EDIBLE. (Fig. 35.)

This little mushroom is generally very abundant in the late spring and early summer, and sometimes in the autumn. It grows about the bases of

stumps or trees, or from wood buried in the soil. It forms in dense tufts of ten to thirty, sometimes several hundred coming up from the roots of a dead tree or stump, forming large masses in the lawn or boulevard. It is sometimes found on logs in the woods.

The plant gets its name from the numerous glistening scales on the cap, causing it to appear as if powdered with mica.

The cap is oval, then bell shaped, with fine lines from the centre to the edge. When young it is covered with glistening mica-like scales. The colour is tan, light buff or tawny yellow. The cap is 1 to 2 inches broad.

The stalk is slender, smooth, white, hollow, 1 to 3 inches long.

The gills are at first white, finally becoming black.

In wet weather the cap and gills melt down into an inky liquid, but may simply dry up at other times.

PANAEOLUS

These mushrooms are very frequently found on dung or in very heavily manured soil. The gills become black and are frequently mottled. They differ from the Ink Caps in not melting down to an inky liquid. As a rule the plants are small.



FIG. 35.—Mica Cap. Edible. Natural Size (Original).

BUTTERFLY MUSHROOM (*Panaeolus papilionaceus*, Fr.). **POISONOUS.**
(Fig. 36.)

This is an attractive little mushroom generally growing on dung. The cap is about one inch broad and is smooth at first, then becomes scaly. The stalk is slender, hollow, white at first but soon becomes blackened by the falling spores. The gills are black and become spotted as the spores fall away.

It is reported to be mildly poisonous, causing a mild form of intoxication.

Murrill has described a similar form which sometimes invades mushroom beds. He describes the plant (*Panaeolus venenosus*, Murr.) as causing serious poisoning.

POLYPORACEAE (Bracket Fungi or Polypores)

These fungi are usually bracket shaped or shelf-like with the under surface bearing numerous small holes like pin holes, called pores. In a few cases the plants are umbrella shaped with a central stalk but in place of gills the under side of the cap is filled with small holes or pores.

A—Plants umbrella shaped with a central stalk—*Boletus*, page 40.

B—Plants bracket shaped or shelf-like.

(1) Pores occurring in separate tubes — Beefsteak fungus, *Fistulina*, page 41.

(2) Pores occurring in the continuous substance of the under surface.

(1) Plants fleshy to corky, Polypores—page 42.

(2) Plants hard and woody, Fomes—too hard to be edible.

(3) Plants leathery, *Polystictus*—too tough to be edible.

BOLETUS

These plants resemble the common mushrooms in shape and are soft and fleshy but instead of bearing gills under the cap they have numerous small holes in cap substance.



FIG. 36.—Butterfly Mushroom. Original.

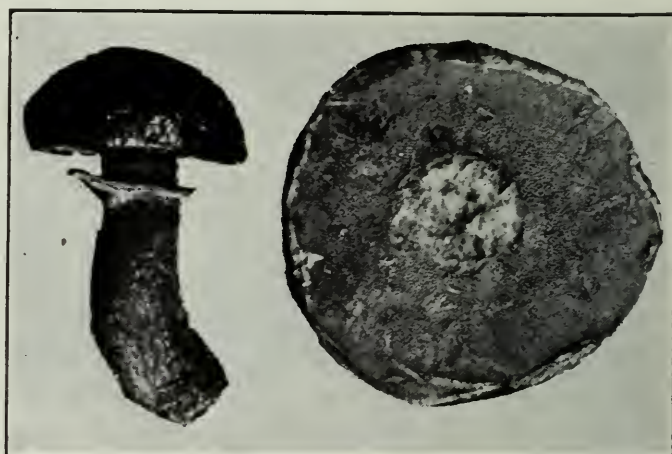


FIG. 37.—Yellow Boletus. Original.

YELLOW BOLETUS (*Boletus luteus*, L.). EDIBLE. (Fig. 37.)

This fungus has a cap 2 to 3 inches broad and yellowish brown to greyish brown in colour. The cap is smooth and somewhat slimy when moist. The stalk is 2 to 3 inches long and from one-half to three-quarters

inch thick. There is a prominent ring on the stalk and the stalk is dotted with little dark points, both above and below the ring. It is common in woods having a sandy soil, found in summer and early fall.

EDIBLE BOLETUS (*Boletus edulis*, Bull.). EDIBLE.

This is a very large fungus, the cap being 4 to 8 inches across, and thick and fleshy. It varies in colour from yellowish brown to reddish brown. The flesh is white, not changing when bruised, and has a sweet, nutty taste. The tubes are white when young, becoming greenish when old. The stalk is stout, enlarged into a bulb at the bottom, covered with a net work of fine ridges. There is no ring.

BITTER BOLETUS (*Boletus felleus*, Bull.). INEDIBLE. (Fig. 38.)

This fungus resembles the preceding but the mouths of the tubes are pink. The flesh is white changing to pink when bruised. The flesh is very bitter and unfit for food.

PEPPERY BOLETUS (*Boletus piperatus*, Bull.). POISONOUS.

Resembles the preceding but the flesh is extremely acrid and peppery.



FIG. 38.—Bitter Boletus. Original.

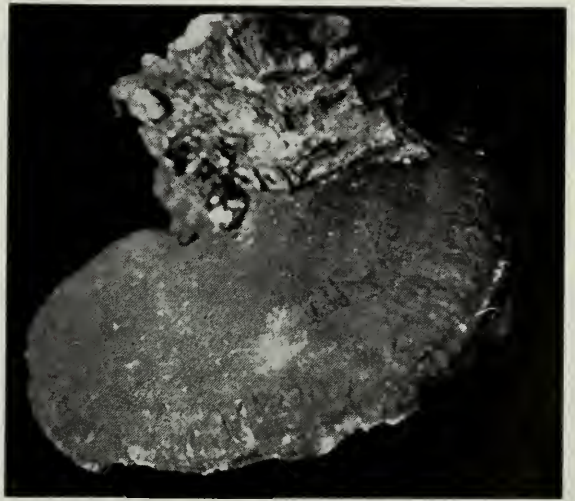


FIG. 39.—Resinous Polypore. Original.

LURID BOLETUS (*Boletus luridus*, Schaeff.). POISONOUS.

This fungus is about the same size as the Yellow Boletus, that is 2 to 5 inches in diameter. The cap is smooth, slightly hairy and reddish brown or yellowish brown. The flesh is whitish, becoming blue when wounded. The tubes are yellowish with the mouths bright yellowish red or cinnabar red. This fungus contains the same poison as found in the Fly Agaric. It grows in open woods having a clay soil.

BEEFSTEAK FUNGUS OR OX TONGUE (*Fistulina hepatica* (Huds.), Fries.).
EDIBLE.

This is a large, heavy, fleshy fungus resembling a piece of raw beefsteak. The fruit body is shelf-like, about 2 to 6 inches across and attached by one side to logs and stumps. The flesh is thick, tough, streaked with dark and light reddish lines; the taste is somewhat acid. The tubes are yellowish and become plainly distinct.

POLYPOROUS

In this genus the plants are mostly corky but a few are fleshy when young and edible. The fruit body is mostly bracket shaped and attached by one side. There are no gills but the under surface of the cap is filled with small holes or pores.

RESINOUS POLYPORE OR BRACKET (*Polyporus resinosus*, Schrad.). EDIBLE.
(Fig. 39.)

This bracket fungus is very common on rotting logs. The flesh is at first firm, somewhat tough, but becomes corky when old. When young it exudes a resinous substance which some consider objectionable. The bracket is 3 to 8 inches wide and dark velvety brown above, and nearly white below.

SULPHUR POLYPORE (*Polyporus sulphureus*, Bull.). EDIBLE. (Fig. 40.)

This fungus also occurs on rotting stumps and logs, and brackets occur in dense clusters and are sulphur yellow in colour. The flesh is at first soft but firm, but later becomes corky.

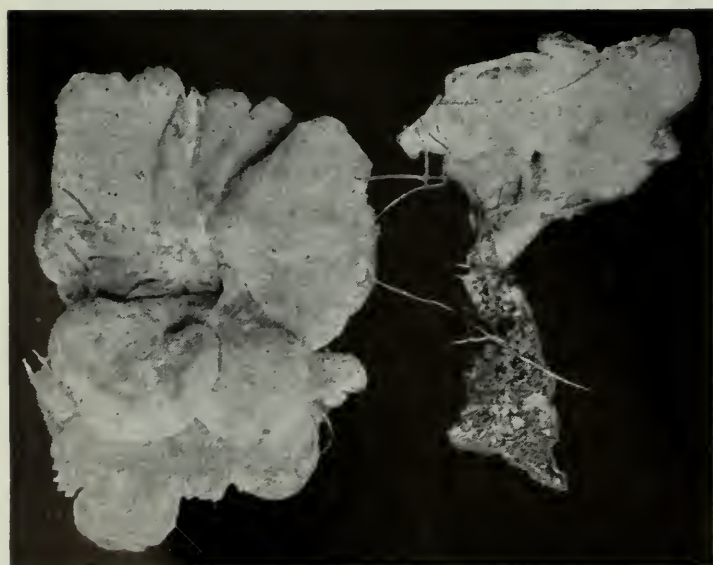


FIG. 40.—Sulphur Polypore.
Original.

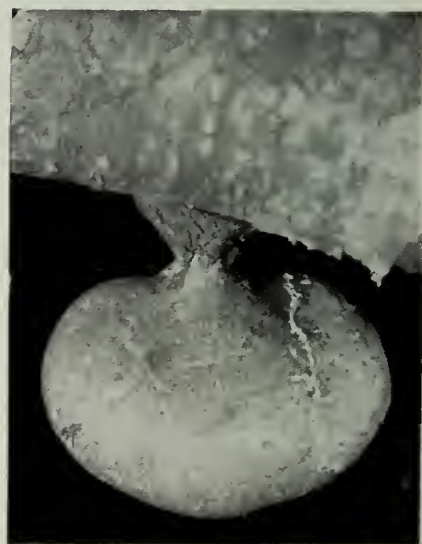


FIG. 41.—Birch Polypore.
Original.

BIRCH FUNGUS (*Polyporus betulinus*, Fr.). EDIBLE. (Fig. 41.)

This fungus is common on birch logs. The cap is somewhat hoof-shaped and is suspended by one side. It is white at first then becomes a smoky grey.

SCALY POLYPORE (*Polyporus squamosus*, Fr.). EDIBLE.

This is a fungus growing on logs or stumps, sometimes on standing trees. There is usually a thick short stalk at one side. The stalk and cap are white. The top of the cap is covered with large brown or blackish scales. On the under side of the cap there are numerous large pores separated by thin partitions. The pores are usually one-tenth (1/10 inch) in diameter. The cap is usually 3-8 inches broad and quite thick. The cap is at first firm, fleshy, but finally becomes more or less corky. When young the fungus is edible.

HELVELLACEAE—MORELS

This group of mushrooms is easily distinguished. The stalk may be hollow or fluted, the cap firmly attached to the stalk and in some forms covered with broad shallow pits separated by a net work of low ridges, or the cap may be simply crisped or wrinkled.

There are three genera of fungi in this group, *i.e.*, True Morels (*Morchella*, Sp.), False morels (*Gyromytra*, Sp.), and Fall morels (*Helvella*, Sp.).

TRUE MORELS (*Morchella*, Sp.).

In this genus the stalk and cap are hollow and the cap or head is completely fused with the stalk forming a continuation of it. The cap is covered with many large pits nearly regularly arranged somewhat like the cells in a honeycomb. The pits are separated by thin partitions.

THE COMMON MOREL (*Morchella esculenta*, Pers.). EDIBLE. (Fig. 42.)

This is one of the best of the few edible fungi which occur in abundance in spring and early summer. May and June are the months in which this fungus occurs in abundance. The plants usually grow under broad-leaved trees such as poplar, sometimes in orchards and occur to a limited extent in evergreen woods.

The fungus usually grows 3-6 inches high and its cap is 2-4 inches long and about twice as wide as the stalk. The stalk is white to buff, smooth and hollow. The cap is white to dark buff and is covered with coarse deep pits 1/4-1/2 inch in diameter and the pits are quite regularly arranged and separated by thin ridges.



FIG. 42.—Common Morel. Original.



FIG. 43.—Narrow Headed Morel. Original.

NARROW HEADED MOREL (*Morchella angusticeps*, Pk.). EDIBLE. (Fig. 43.)

This Morel resembles the preceding but the head is much narrower, scarcely any wider than the stalk.

BIG STALKED MOREL (*Morchella crassipes* (Vent.), Pers.). EDIBLE. (Fig. 44.)

This Morel has a short head and a thick stalk. It grows in places similar to the two preceding.

FALSE MOREL (*Gyromytra esculenta*, Fr.). POISONOUS. (Fig. 45.)

This fungus develops in the spring and early summer (May and June) on the forest floor in the leaf mould. It is frequently associated with the true morel.

The fruit body is from 2 to 4 inches broad and 2 to 5 inches high. The stalk is white and hollow and from 1 to 2 inches long. The head is usually much broader than the stalk and buff to brown in colour. Instead of the broad pits, the head is covered with irregular grooves or creases with broad blunt ridges between them. The head is described as convoluted, that is, marked like a brain.

The plant is sometimes listed among edible fungi but in recent years there have been a number of cases of fatal poisoning due to this fungus.

It should be avoided.

FALL MORELS OR SADDLE FUNGI (*Helvella*)

In this genus the stalks are smooth or fluted and the cap is saddle shaped or crisped or wrinkled. The plants are usually found in the fall, generally in the woods.

FLUTED STALK OR FALL MOREL (*Helvella crispa*, Fr.). EDIBLE. (Fig. 46.)

This is a very pretty plant found growing in the woods in the fall. It is most common in coniferous woods, especially among pine.

The plant is from 2 to 6 inches high. The stalk is generally white or dusky grey and carved and fluted with irregular hollows and ridges. The cap is from 1 inch to 2 inches broad, white to brown and very much folded or crisped and wrinkled. It is fully as good as the Common Morel.



FIG. 44.—Broad stemmed Morel.
Original.

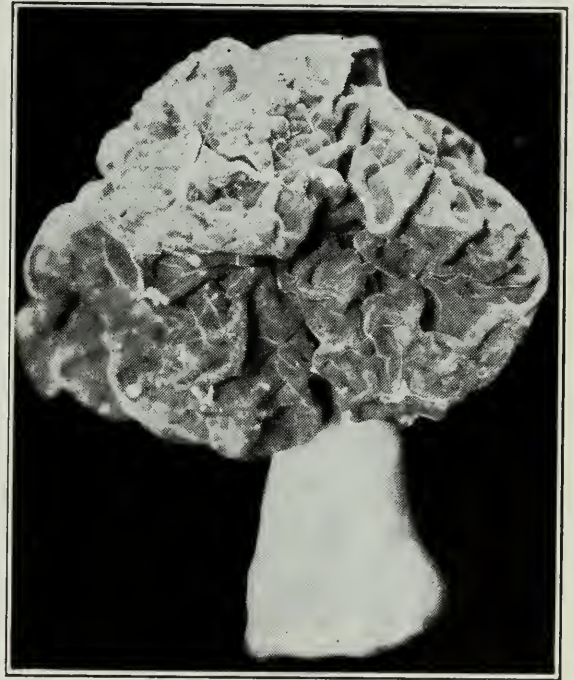


FIG. 45.—False Morel.



FIG. 46.—Fall Morel.
Original.

SADDLE CAP (*Helvella elastica* Fr.). EDIBLE. (Fig. 47.)

This is a much smaller fungus occurring in the same situations as the Fluted Stalk. The stalk is white, slender and smooth. The cap is white, becoming greyish brown and saddle-shaped. The plant is seldom more than 3 inches tall and the cap one-half to three-quarters inch wide. It is not as good as the preceding, the stalks are often tough.



FIG. 47.—Saddle Cap. Original.

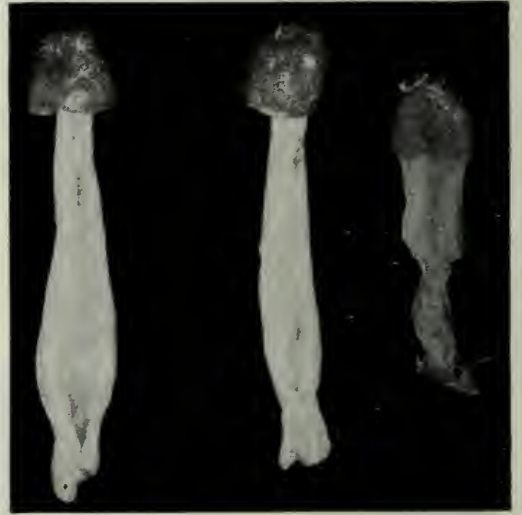


FIG. 48.—Thimble Cap. Original.

THIMBLE CAP (*Verpa digitaliformis*, Pers.). EDIBLE. (Fig. 48.)

A small fungus found in spring. The stalk is white and slender, about 2 inches long, and smooth. The cap is thimble shaped and fits over the top of the stalk like a thimble. The cap is generally greenish brown.

PHALLACEAE OR STINKHORNS

This is a peculiar group of fungi which, when mature, gives off a very unpleasant, carrion-like odour. It is probable that spores are carried by flies. In young stages the fruit bodies are egg shaped. Upon cutting open the egg the stalk and cap can be seen inside, imbedded in a gelatin-like substance. In this stage the fruit body resembles that of the Deadly Agaric. At maturity the stalk rapidly elongates, often four to five inches in an hour, and carries up the brownish cap. Very soon the cap begins to melt down, giving off carrion-like odour.

FRILLED OR NETTED STINKHORN (*Dictyophora duplicata* (Basc.), Fisch.). (Fig. 49.)

This is the largest and most evil smelling of the stinkhorns. The fruit body is 6 to 8 inches high. The stalk arises from the "egg" leaving at its base the cup-like or bag-like volva or poison cup. The cap is about 1 inch to 2 inches broad and with shallow pits. The cap is at first brown but the

brown substance dissolves and drops away leaving a white pitted cap which looks a little like a Morel. A delicate lacy frill or skirt hangs down from under the cap, reaching about half way to the base.

The plant is said to be edible in the egg stage but it resembles the Deadly Agaric in this condition. When mature the disgusting odour would prevent anyone from collecting it.

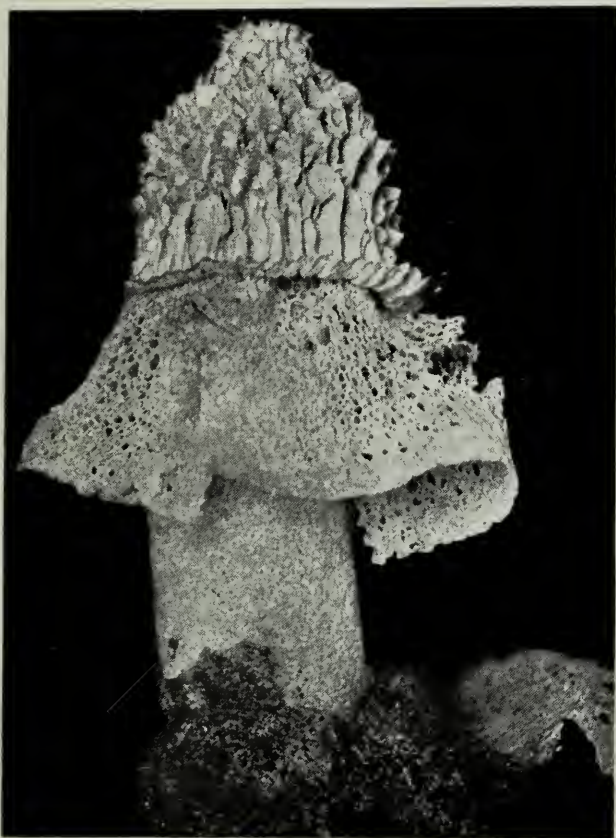


FIG. 49.—Netted or Frilled Stinkhorn.
Original.

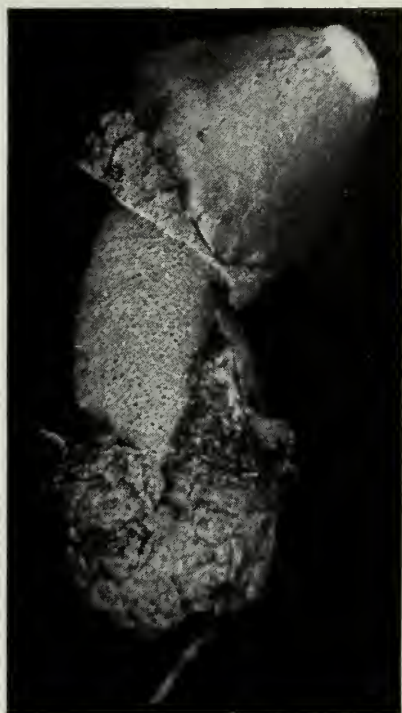


FIG. 50.—Common Stinkhorn.
Original.

COMMON STINKHORN (*Phallus impudicus*, Linn.). (Fig. 50.)

This is a somewhat smaller fungus than the preceding being only 4 to 6 inches high and it lacks the lacy frill or skirt. The cap is distinctly pitted. It does not have quite as pronounced an odour as the Frilled Stinkhorn but still a single plant may be detected five or six rods away. One would scarcely collect it for table purposes.

SMALLER STINKHORN (*Lysurus borealis*, Burt.). (Fig. 51.)

This fungus is only about 2 inches tall. It resembles the Common Stinkhorn very closely but the head is divided into four parts by four white longitudinal ridges. The plant has the same odour as the others only scarcely as pronounced.



FIG. 51.—Lesser Stinkhorn.
Original.

There are a few other plants in the Stinkhorn group but they may all be detected by the odour.

LYCOPERDACEAE — PUFF BALLS.

The puff balls are very common in woods and grassy places. The fruit body varies in size from half an inch in diameter for the smallest one to 2 feet in the Giant Puff Ball. When young the interior is uniform in composition, white in colour and somewhat cheesy in character. No indication of a cap or stalk can be seen so they can readily be distinguished from the egg stage of the Deadly Agaric and from the Stinkhorns. At maturity the interior of the ball becomes brown and powdery. A slight pressure will cause the spores to puff out in a dense cloud.

GIANT PUFF BALL (*Lycoperdon giganteum*, Batsch.). EDIBLE. (Fig. 52.)

This fungus sometimes occurs abundantly in pastures and on roadsides in August and September. The fruit body is very large, usually 8 to 15 inches in diameter or even larger. In 1915 a report was received by this Department of six of these puff balls weighing 48 pounds, two just as large and a dozen smaller ones, all found on a piece of ground but 2 rods square. There are reports of these puff balls which were over 3 feet in diameter and weighed 47 pounds.

The fruit body is flattened ball shaped. It is at first pure white and quite smooth. Later it becomes light yellowish brown, and then cracks into many fine areas. When young the interior of the ball is white and cheesy, but when it becomes old it breaks up into a yellowish or snuff-coloured powdery mass.

The puff balls should be gathered while still white inside.

If one succeeds in finding a single one of these balls he is assured of having several mushroom feasts.

CLUSTERED PUFF BALL (*Lycoperdon pyriforme*, Schæff). EDIBLE.
(Fig. 53.)

This is a much smaller fungus, the ball being only 1 to 2 inches high. It grows on old timber or on the ground, but the balls occur in great numbers, sometimes forming dense clusters several feet across. The fungus is excellent while still white inside. It is most commonly found in woods from July to October.

CRESTED OR TOP-SHAPED PUFF BALL (*Lycoperdon gemmatum*, Batsch.).
EDIBLE. (Fig. 54.)

This is one of the smaller puff balls. The fruit body is more or less top-shaped, 1½ to 3 inches high. It grows singly or in small clusters. It is white at first, but becomes grey to dirty brown in age. The young specimens are ornamented on top with many small points or warts which disappear. Finally the fruit body opens by a round hole in the top and the fine powdery spores are puffed out through this opening. It may be found on the ground in the woods or in open places.



FIG. 52.—Giant Puff Ball.
A remarkable find.
(This will furnish good eating for some
time and many friends.)



FIG. 53.—Clustered Puff
Ball. Original.



FIG. 54.—Crested Puff
Ball. Original.

ORNAMENTED PUFF BALL (*Lycoperdon pulcherinum*, B. & C.). EDIBLE.
(Fig. 55.)

This is one of the smaller puff balls. It is only 1 inch to 2 inches in diameter. It is ornamented on top with numerous pointed scales.

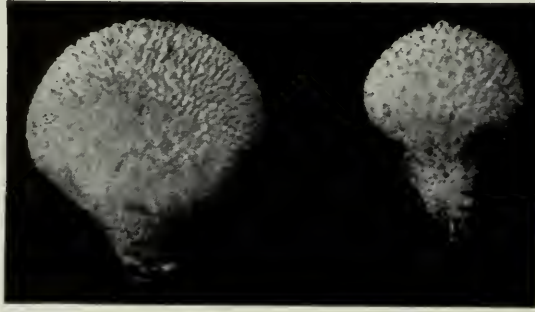


FIG. 55.—Ornamented Puff Ball.
Original.

SKULL-SHAPED PUFF BALLS (*Lycoperdon craniformis*, Schw.). EDIBLE.
(Fig. 56.)

This is one of the larger puff balls. It is 6 to 10 inches in diameter and more or less skull-shaped. The outer layer of the ball is often cracked or checked into small irregular areas. The colour is generally white but becomes dingy or grey in age. This puff ball differs from the Giant Puff Ball in being smaller and when mature only the upper two-thirds break up to form the powdery mass. The lower third remains behind as a solid base which is slightly hollowed out at the top. It is just as good as the Giant Puff Ball, and like it, should be gathered before there is any indication of browning in the interior.



FIG. 56.—Skull-shaped Puff Ball.
Original.



FIG. 57.—Earth Star.
Original.

EARTH STAR (*Geaster triplex*, Jung.). (Fig. 57.)

This fungus resembles the puff balls in many respects. When the fruit bodies are young they are ball-shaped and the interior filled with a white cheesy material. Just before they are mature the outer wall becomes separate from the inner part which forms a distinct ball enclosed in an envelope. In this stage they might be mistaken for the young stage of the Deadly Agaric but no distinct cap and stalk are formed. As the fruit body matures the outer envelope splits along several lines and then rolls back so that we have an inner part shaped like a puff ball surrounded by a star-shaped envelope.

The Earth Stars have not been listed as edible.

CORAL FUNGI—(CLAVARIACEAE).

These fungi are upright growing forms growing on wood or on leaves on the forest floor. Most of the species are much branched with ascending branches but one or two forms are simply upright clubs. The Coral Fungi vary in colour from white through yellow to brown, mostly white or yellow. The tips of the branches are often bright coloured. All the Coral Fungi are edible and no one need have any fear in collecting them.

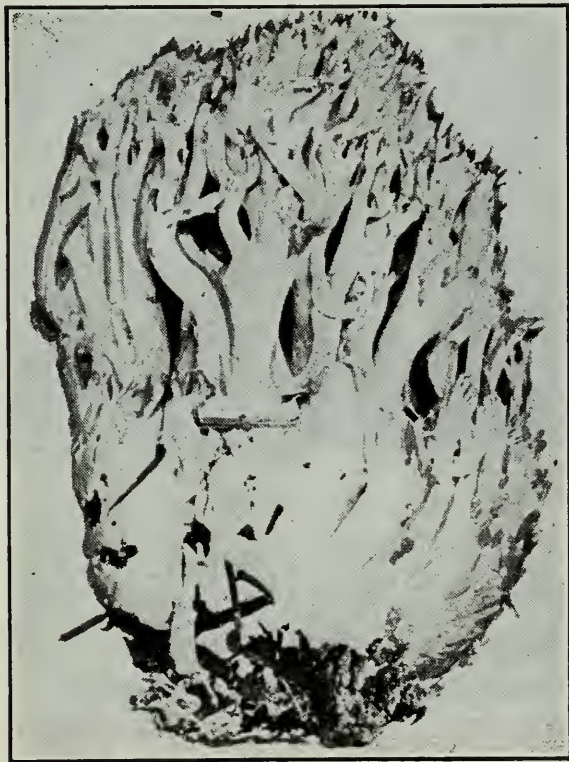


FIG. 58.—Coral Fungus. Edible.
Natural Size (Original).

YELLOW CORAL FUNGUS (*Clavaria flava*, Schæff.). EDIBLE. Fig. 58.)

This fungus occurs commonly in the woods, growing on stumps and rotting logs and is most abundant in warm wet weather in the summer and early autumn.

The plant is 3 to 6 inches high and 2 to 4 inches broad. At the base it is thick and fleshy, but the upper half is divided into numerous upright, pale yellow branches. As the plant becomes old it fades to a dingy white. The flesh is firm, white and solid.

BEAUTIFUL CORAL FUNGUS (*Clavaria formosa*, Pers.). EDIBLE. (Fig. 59.)

This fungus occurs in the same situations as the preceding, but differs from it in being much more branched and having a less prominent base.

FAIRY CLUB (*Clavaria pistillaris*, L.). EDIBLE.

This is one of the unbranched forms and grows up from the forest floor as a simple club-shaped fleshy stalk. The club is usually 2 to 5 inches high and from one-half to one inch in diameter at the top. It is firm, fleshy and is slightly acid when grown, but this acidity disappears in cooking.



FIG. 59.—Coral Fungus. Original.

HEDGEHOG FUNGI OR TOOTHED FUNGI—HYDNACEAE.

The Toothed Fungi are mainly medium sized to large plants growing on logs, stumps and standing trees. In many cases the fruit body is much branched, bearing many spines or teeth which hang downward. In some cases there is a distinct head with spines on the under side. In colour they vary from white through yellow to brown. None of the forms are poisonous, but some are too tough and hard to be edible.

HEDGEHOG FUNGUS (*Hydnum erinaceum*, Bull.). EDIBLE. (Fig. 60.)

This fungus is common on logs and stumps in the woods. It forms large white masses four to five inches across. There is a firm, fleshy base

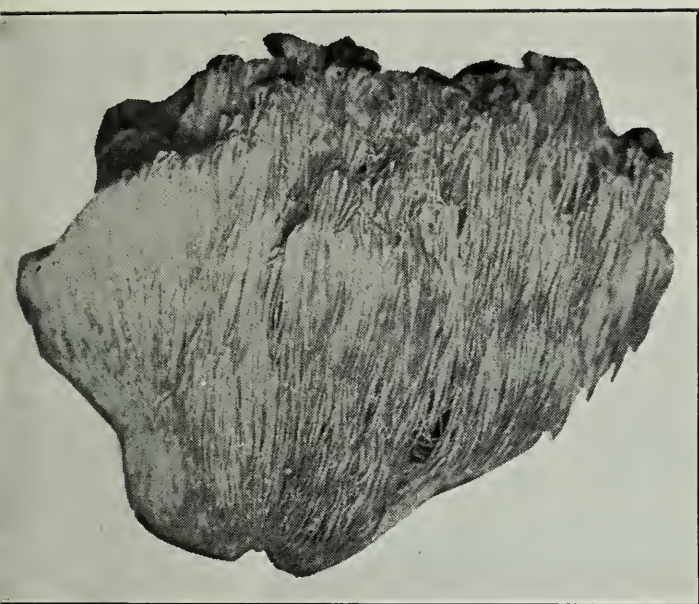


FIG. 60.—Hedge Hog Fungus. Edible. Natural Size (Original).

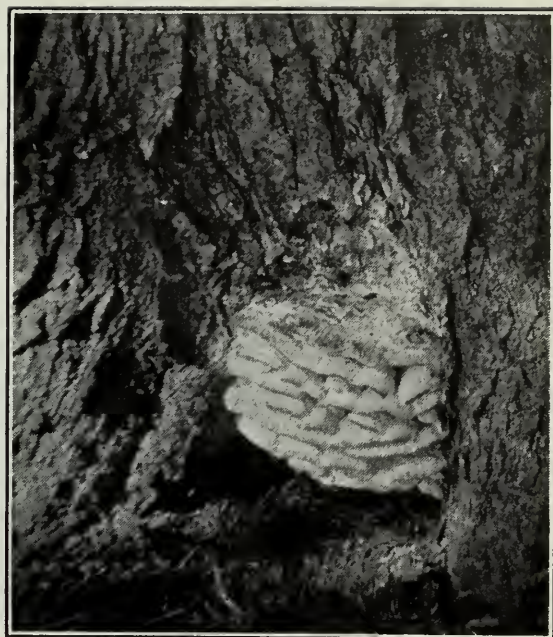


FIG. 61.—Northern Hydnum. Original.

from which are developed short branches bearing slender spines which point downward.

Some other fungi which closely resemble this are the Medusa Head (*Hydnum caput medusae*) which has the base more branched and still longer spines, and the coral-like Hydnum which is branched like the coral fungi.

THE NORTHERN HYDNUM (*Hydnum septentrionale*, Fr.). (Fig. 61.)

This is a very large fungus often weighing eight to ten pounds. It consists of numerous overlapping shelves which bear spines on the under side. The fungus generally grows on standing trees and is seen issuing from wounds. It is generally light yellow in colour and is too tough and tasteless to be edible.

CUP FUNGI—PEZIZACEAE.

These fungi produce cup-shaped fruit bodies which vary much in colour; some are white with scarlet interior, some yellow with a golden interior, some light brown throughout. They vary in size from half an inch to two inches. Usually the flesh is somewhat gelatinous and becomes slimy when cooked. They are edible but not very good.

SCARLET CUP (*Peziza coccinia*, Jacq.). (Fig. 62.)

This fungus produces a cup which varies from one-half inch to one inch in diameter. If the cup arises from a piece of rotting wood buried in the soil it may have a distinct stalk. The stalk and outside of the cup are pure white, while the interior of the cup is bright red or scarlet. It is usually one of the common spring fungi.

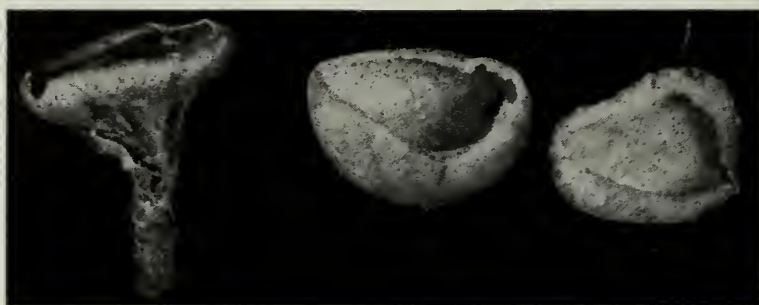


FIG. 62.—Scarlet Cup. Original.

LITERATURE.

Those who are interested in mushrooms can obtain further information on them from the following books:

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- Marshall, Nina.—The Mushroom Book.—Doubleday, Page Co., New York.
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MUSHROOM GROWING

In some countries mushroom growing is a considerable industry. Originally advantage was taken of locations where temperature and moisture conditions could be easily and cheaply controlled. In Paris the underground passages and catacombs were utilized. In some regions natural caves were used. In some places in the United States abandoned coal mines make good situations for mushroom growing. As the industry

has developed it has been desirable to grow mushrooms in localities more conveniently situated to markets where such more or less natural situations were not available. In many districts it has been found advisable to build mushroom houses that could be heated in cold weather and cooled in warm weather to keep the beds at an ideal temperature for the crop. Such establishments are elaborate and costly.

Many people would like to grow mushrooms on a small scale for home use or for local market. For such limited productions elaborate mushroom houses are not necessary. Mushrooms may be grown in any place where conditions of temperature and moisture can be kept favourable. A cellar, cave, a basement or a vacant place under greenhouse benches may be utilized for this purpose. Sheds are not usually suitable.

In regions with a cool, moist climate mushrooms may be grown outdoors, but the climate of Ontario is not suitable for outdoor culture of mushrooms.

TEMPERATURE

The most important factor in growing mushrooms is, apparently, the maintenance of a suitable temperature. In order to produce a good crop of mushrooms the temperature must be controlled within narrow limits; high temperatures being especially injurious as diseases and some insect pests are almost sure to develop. Low temperatures delay growth, but do not spoil the crop. For profitable production the temperature should not be lower than 50° Fahrenheit, nor higher than 65° Fahrenheit. The proper temperature ranges between 53° and 60° with the ideal temperature between 55° and 58°. Fluctuating temperatures are very harmful. With the temperature above 60° moulds and rots are almost sure to develop and destroy the crop.

Hot water heat is the best. Steam heat is very satisfactory. In small places coal or wood stoves may be used, provided there is plenty of ventilation to furnish plenty of fresh air. Kerosene or gas stoves are not recommended.

It is difficult to grow mushrooms in the summertime unless a cooling system is available.

MOISTURE

The moisture factor is next in importance. With an atmosphere saturated with moisture and water dripping from the walls, a very poor crop can be expected. On the other hand, if the air is too dry the beds cannot be kept sufficiently moist. The air should be kept fairly moist, about 60-75 per cent. saturation, so that there will be a gradual evaporation from the beds.

The beds should be kept fairly moist but not wet. They should never be drenched with water but should be gently sprinkled with a fine rose.

It is impossible to say how much water should be applied as this will vary with temperature and ventilation. When the room is dry the beds may require sprinkling twice a day. In a cave or cellar they may not require watering oftener than once a week. The water applied should be about the same temperature as the room.

A good water supply should be near the beds so that they can be easily watered. The water should be good, fresh, and of the same quality used for drinking purposes.

VENTILATION

Mushrooms need plenty of good fresh air. However, the ventilation should be so arranged that there are no direct draughts on the beds and the air should be gradually and constantly changed.

LIGHT

Mushrooms do not require light for their development. On the other hand, light is not necessarily detrimental. Sunlight is accompanied by heat, and it is generally more difficult to control temperature in a lighted room. The air in a sunlit room tends to become hotter and drier during the day and cooler and damper at night. If temperature and moisture can be controlled, sunlight will do no harm. It is usually easier to keep temperature and moisture uniform in a cave or cellar than in a barn or greenhouse.

MATERIAL TO USE IN GROWING MUSHROOMS

Since mushrooms do not have leaves they cannot manufacture their own food as green plants do. Everything that they need for growth must be supplied to them in the beds in which they are growing, and this food must be organic in nature.

The best material upon which to grow mushrooms is a compost, made from fresh horse manure. The manure may contain considerable straw, but not too much long, coarse material. The best manure will be quite damp, containing a large amount of urine. Manure containing shavings or sawdust is not so good. Garden refuse should not be used. Manure from veterinary hospitals should be discarded, as it contains quantities of disinfectants, which will prevent the growth of the mushrooms. Under present conditions, street sweepings cannot be used as they contain too little manure and urine and too much oil.

Although many experiments have been tried, a satisfactory substitute for horse manure has not been discovered.

THE QUANTITY OF MANURE REQUIRED

A grower should be able to calculate fairly accurately the quantity of manure required for beds of any size. A carload of manure, about twelve

to fourteen large wagons, *i.e.*, twenty-four to thirty tons will be sufficient to make a bed of about 3,000 square feet. A small wagonload, say a ton, will make a bed of about 100 square feet; *i.e.*, a bed five feet wide and twenty feet long. This quantity will vary with the quality. Manure containing much coarse straw will have to have the coarse material removed and so there will be a smaller amount of manure for the compost, and smaller beds will have to be made, or more manure obtained.

PREPARING THE COMPOST

Fresh manure is not suitable for mushroom growing; it must be cured or fermented before it can be used. This curing is called composting. If the curing is not properly done a good crop cannot be expected. On the other hand, old, rotten manure has lost most of its food suitable for mushrooms; so in order to get the best results fresh manure is taken and composted to just the proper condition.

The fresh manure should be well shaken to rid it of coarse straw and to mix it thoroughly. It should then be placed in a pile about 3 feet deep. If it is dry it should be moistened but not soaked with water. It should be packed with the fork but not tramped. It will now begin to get warm and ferment, and care must be taken that it does not get so hot that it will burn, *i.e.*, become white and dry in the interior of the pile. If the pile becomes very hot, it should be turned and the material again moistened. The manure should feel moist to the hand but should never drip water when squeezed or pressed.

It is best to keep the pile under cover so that none of the material will be lost by leaching. Furthermore, it should not be allowed to freeze. The best time to ferment the manure is September or October, though it can be done in late August.

While fermenting, the manure will attain a temperature of 100° to 150° Fahrenheit, but after the first week should gradually become cooler. After it has cooled down to 70° it should be ready to use. If the fermentation is thoroughly done the manure will, by this time, have lost all objectionable odour; it will have an odour suggesting mushrooms; it will have a slightly greasy feel. The straw will have a uniform dark brown colour, and will break or shear cleanly when twisted in the hands, and the droppings will appear as a brown powder.

MAKING THE BEDS

For growing mushrooms in small quantities beds may be made directly on a cellar floor or under the greenhouse benches. The boxes, a foot deep and as large as desired, may be made with sides of board or plank, a bottom is not necessary.

Place in the bottom of the box four or five inches of manure and pack it down tightly. Then add two inches of rich garden soil. Pack down. Add another layer of manure and another of soil and continue until the box is full, taking care to keep the compost firmly packed.

A very simple method of preparing the beds is as follows: Mix thoroughly the manure with good garden soil, using three bushels of manure to one bushel of soil. Place the compost in the boxes prepared and pack firmly by tamping with a brick.

Some prefer not to use soil at all but simply fill the beds or boxes with compost.

The beds should be firm and smooth with no hollows. After the beds are filled they should be tamped by hand with a tamper, made from a piece of board 12 inches square and 1 inch thick. The compost should never be tramped with the feet.

LARGER MUSHROOM BEDS

If space is available, mushroom beds may be built up in tiers, as shown in the accompanying diagram. The tiers may be as high as desired.

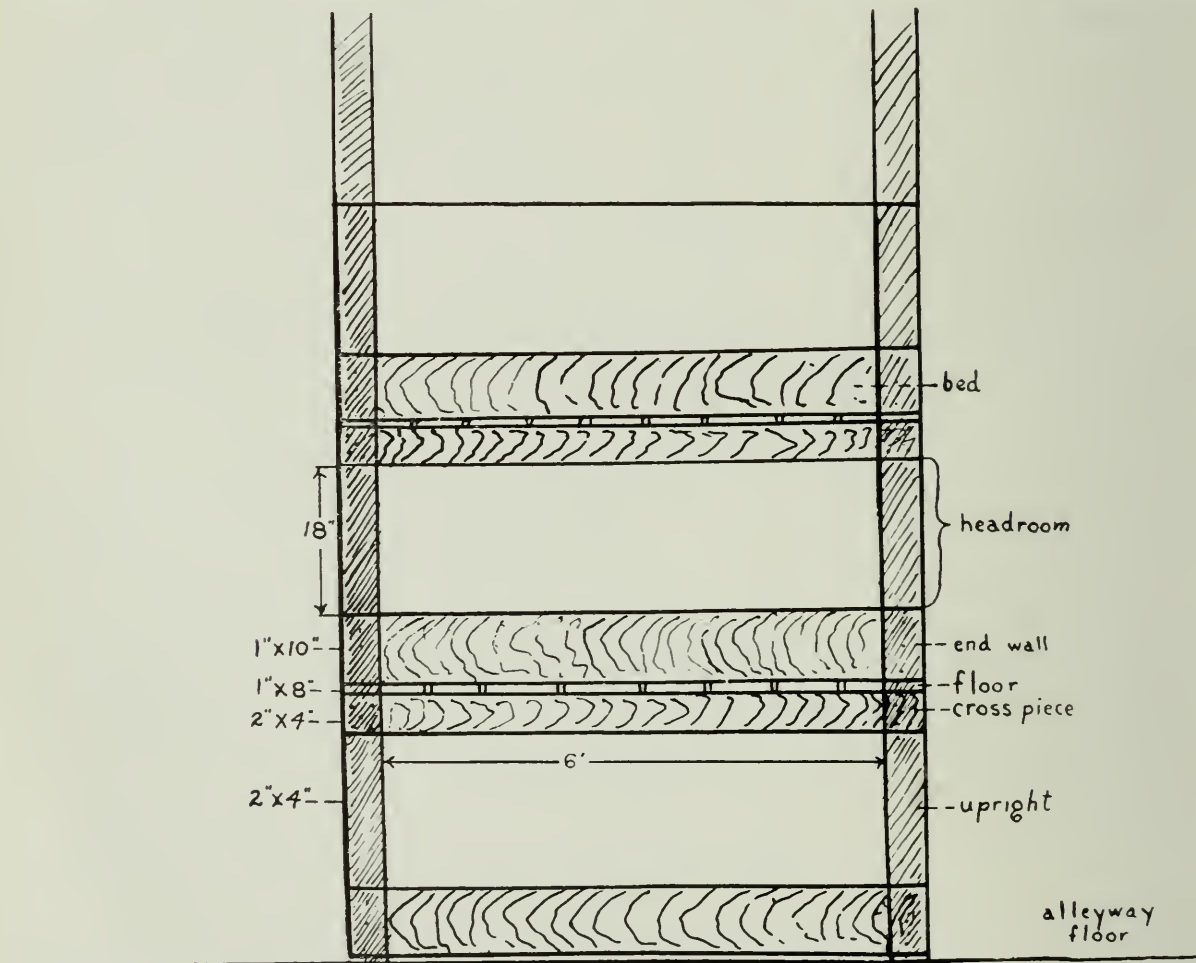


DIAGRAM I.—End view of tier of mushroom beds, showing dimensions of lumber and spacing.

In building such beds the dimensions will vary with circumstances. If single beds are built against a wall they should not be more than three feet wide so that the grower will not pack the beds in tending and harvesting the crop. If enough space is available double beds, with access to each side, may be built. In this case the double bed may be five (5) or even six (6) feet wide.

When beds are made in tiers the supporting uprights may be made from 2 x 4 lumber, spaced at intervals of four (4) feet along the bed, and extending to the ceiling or joists above. The cross pieces may, also, be made of 2 x 4 pieces. The floor of the beds may be made of 1 x 8 boards, laid loose on the cross pieces. The sides of the beds can be made of 1 x 10 boards or, if a deeper bed is desired, two 1 x 6 inch boards.

In arranging the tiers, headway of at least 18 inches should be allowed between the top of one bed and the bottom of the bed above. (See diagrams 1 and 2.)

When installing such a system, new lumber is best, but old lumber may be used if it is not badly checked or split. Old lumber that has been used in mushroom beds before, or that has formed part of hot beds or cold frames, or that which has been in contact with manure, should be thoroughly cleaned and sterilized before it is used.

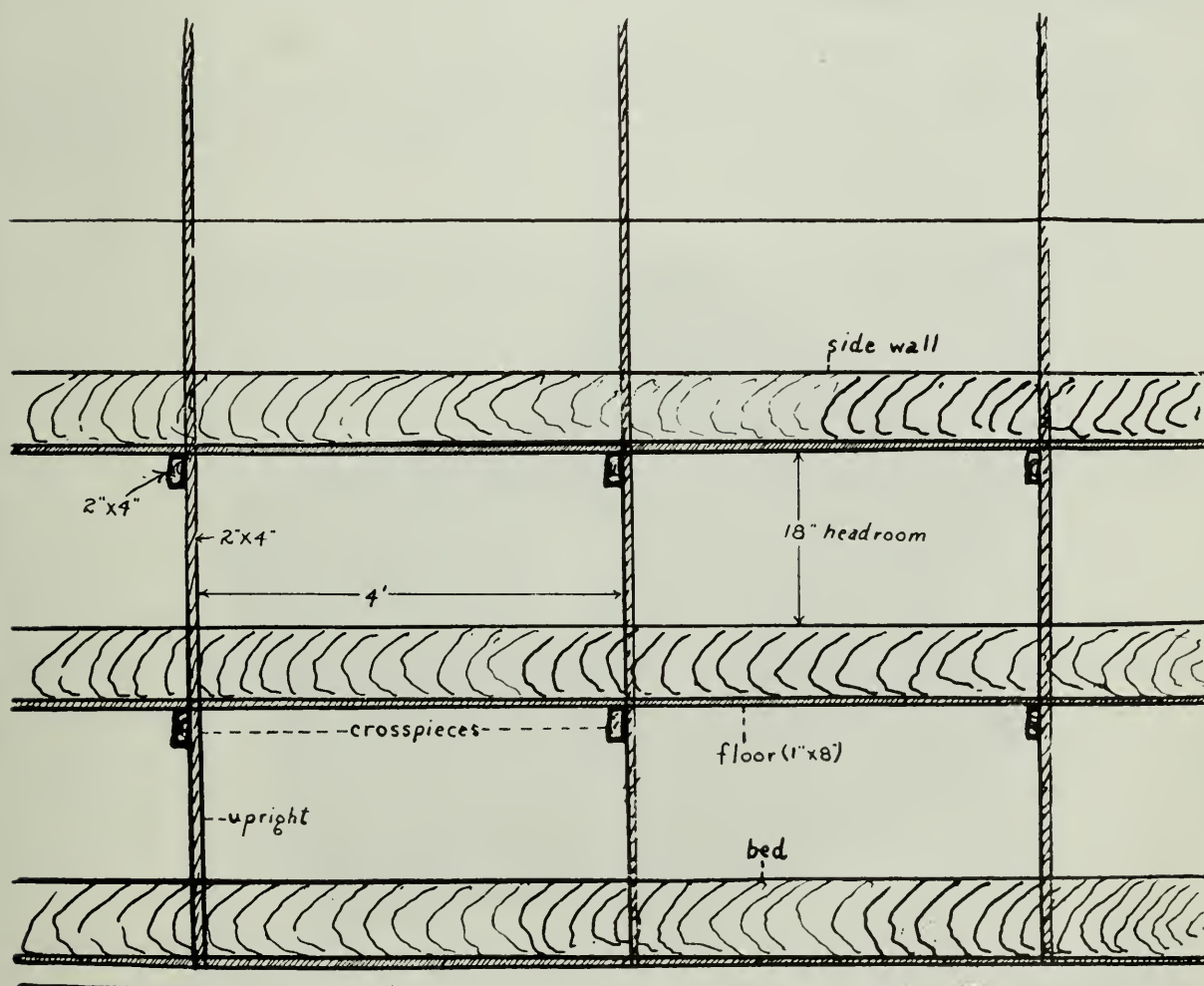


DIAGRAM II.—Side view of tier of mushroom beds, showing arrangement of the beds.

PLANTING OR SPAWNING

In growing mushrooms we do not grow them from seed or spores, but from spawn which is the mycelium of mushrooms already established in compost.

MUSHROOM SPAWN

Mushroom spawn is a specially prepared compost containing the mycelium or living threads of the mushroom plant. This mushroom spawn can be purchased from many dealers in seeds and gardeners' supplies. Mushroom spawn is put on the market in several different forms.

No. 1—*Brick Spawn*.—This is the old standard spawn which has been most commonly used up to the present time. Brick spawn is a hard, dry block of compost about $8\frac{1}{2}$ inches long, $5\frac{1}{2}$ inches wide and from 1 to $1\frac{1}{2}$ inches in thickness. This block of compost, while still moist, had mushroom mycelium planted in it. This mycelium grew until the brick was quite densely filled with mushroom threads. The brick of compost was then dried and put in storage. This brick spawn is on the market and can be obtained from most seedsmen and dealers in gardeners' supplies. (See Figure 63.)

No. 2—*Flake Spawn*.—Very little flake spawn is for sale in this country. Flake spawn is simply a loose mass of compost containing mushroom threads. It is a very good type of spawn if it can be obtained while strictly

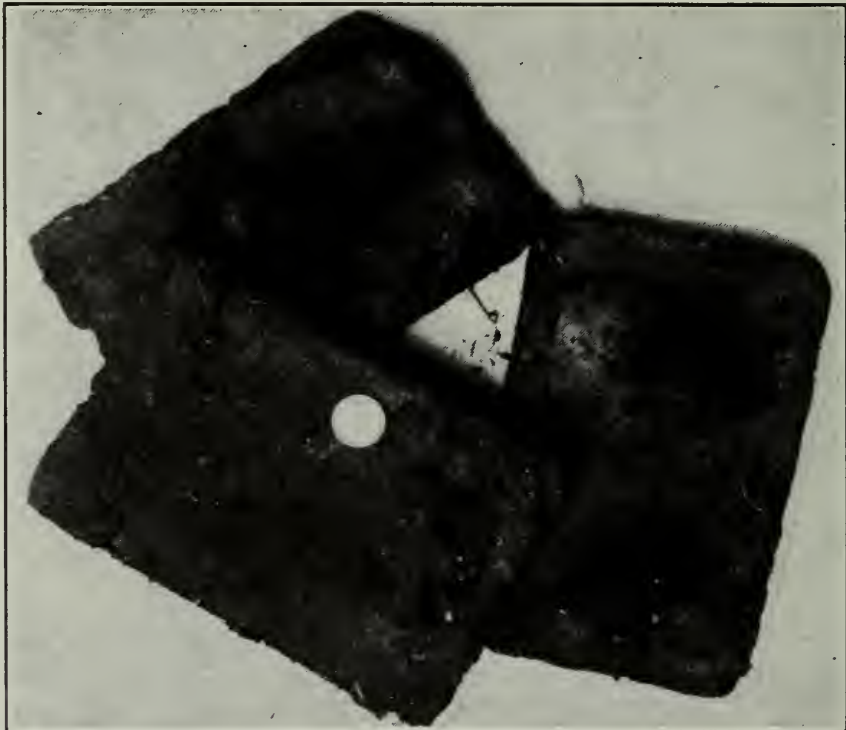


FIG. 63.—Brick Spawn.

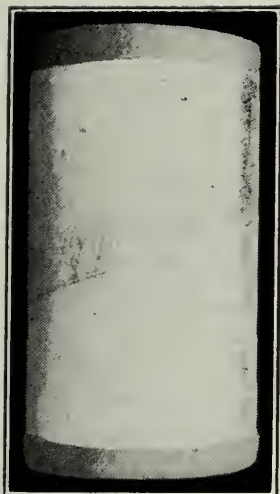


FIG. 64
Carton Spawn.



FIG. 65
Bottle Spawn.



FIG. 66.—Spawn
removed from bottle.

fresh and in its moist condition, but there is little or none available in this form in this country.

No. 3—*Carton Spawn*.—Some spawn companies have developed a method of shipping spawn in very fresh condition in pasteboard cartons. At the present time many of our large growers order their spawn in this condition from mushroom spawn companies. Typically, this spawn arrives in fresh, moist condition, and is held in cool storage for a few days, until the beds are ready to plant.

No. 4—*Bottle Spawn*.—The last few years many mushroom spawn companies have developed the system of growing mushroom spawn and sending it out packed in quart bottles. The quart bottle is first sterilized and then filled and closely packed with compost. This material is then inoculated with the mycelium of a named variety of mushroom threads. In a very few days the compost in the bottle becomes filled with mushroom threads. This is called bottle spawn. Figure 65 shows the bottle spawn as it is placed on the market. Figure 66 shows the bottle spawn with the bottle removed and ready for breaking into pieces for planting. The bottle spawn when in proper condition should be moist and the compost densely filled with white threads. It is claimed by the mushroom companies that this bottle spawn is much purer and truer to name than brick spawn and, also, since it is in a fresh, moist condition, will start growing much more rapidly when planted and is much surer to give a crop and the crop itself will develop from a week to ten days earlier than good brick spawn. This, of course, would depend upon the relative freshness of the two types.

No. 5—*Packet Spawn*.—For growing mushrooms on a very small scale, spawn may be put in packets, resembling seed packets. This is usually quite dry and a packet is about enough to spawn a bed 5 feet wide and 2 feet long. Some of this packet spawn has given good results.

No. 6—*Granular or Grain Spawn*.—This is a new type of spawn. The mycelium is grown on grain, such as wheat or rye, and has the appearance of coarse granules or grains covered with white mould. This type of spawn should be convenient for use on a limited scale.

No. 7—*Tobacco Spawn*.—Some spawn companies are now using old tobacco stems in making up the compost on which to grow their mushroom spawn. They claim that this material is less liable to become contaminated with insects than the standard type of material.

SPAWNING

After the beds are made they should heat up to some extent but will shortly cool down again. When they have cooled down to 70° Fahrenheit the spawn may be planted.

The bricks of spawn are broken into pieces about 2 inches square. A hole about 3 inches deep is then made in the bed and a piece of spawn inserted, pressed firmly down, then covered with compost which is firmly packed. A piece of spawn should be planted to every square foot of the bed. Now smooth the bed and water lightly; then cover the bed with about 4 inches of clean straw or a piece of carpet.

WATERING.—After the beds are spawned, care should be taken to keep the beds moist but not too wet. It is best to apply water in small amounts with a watering pot with a fine rose. Watering should be frequent enough to keep the beds moist. The beds should never be watered with a hose or buckets of water, as in this way parts of them will become drenched and thoroughly soaked with water. This is very likely to kill the spawn.

DEVELOPMENT OF THE CROP.—During the first 10 days the temperature should be held at about 70° Fahrenheit. Within 10 days the spawn should begin to run. The compost near the planted spawn should be filled with new, white threads of mycelium. The temperature should now be dropped to 60 degrees.

After about thirty days the spawn should have grown sufficiently to fairly well fill all the compost in the beds and appear as fans of mycelium at the sides. Small buttons may also be seen at the point of planting.

CASING.—When the above condition is reached the beds should be cased. First any temporary covering should be removed; then the temperature dropped to about 58 degrees F. If the beds are dry they should be carefully watered. Then a layer of garden soil 1½ to 2 inches thick should be evenly spread over the beds. Soil from a garden or a well cultivated field should be used. The soil should be fine but should not contain too much sand, no clay and little humus. It should be fairly dry and may be passed through a sieve with a ¼ inch mesh, or at least should be very fine

and all lumps broken up. The soil should be fairly dry so that it will not pack as it is lightly but firmly tamped and smoothed over the bed. After the soil has been smoothed water with a fine rose until it is damp down to the compost.

From this time on the beds should be carefully watched and carefully watered from time to time to keep them moist but they should never be drenched or soaked with water. The temperature should be maintained at about 58 degrees F.

About 6 weeks after planting mushrooms should begin to appear. First in small clusters over the points at which spawn was planted, then more evenly over the beds.

After mushrooms have started to appear the bed should continue to bear for three months or more. It is probable that the mushrooms will not develop regularly but will come in successive crops or flushes. As the beds dry mushrooms will cease but will come on again after watering. If the temperature is allowed to drop to 50 degrees or lower they will probably stop, but will come on again if the temperature is raised to 58 degrees. If the beds are watered too much or if the temperature rises above 60 degrees the mushrooms will damp off, *i.e.*, rot off on the beds. Also if the temperature is too high many mushroom flies will breed and the mushrooms will be destroyed by maggots.

YIELD OF MUSHROOMS.—There is considerable misunderstanding concerning the amount of mushrooms that may be expected from a bed. Many people are disappointed in the amount of mushrooms that can be grown in a small space. Under usual conditions a yield of one pound per square foot is satisfactory. This does not mean a pound per cutting, but a pound per square foot for the entire crop period of three months. Sometimes a yield of two pounds per square foot for the entire crop may be secured, but this is exceptional.

After a bed has apparently ceased to bear it should not be immediately discarded. A careful examination of the bed should be made and if the spawn in the bed appears white and fresh looking a thin layer of a mixture of thoroughly rotted compost and rich garden soil may be added to the top of the bed. If this is then well watered, a further flush of mushrooms may sometimes be developed.

When no more mushrooms appear and the spawn upon examination does not seem to be fresh and white, the beds should be thoroughly cleaned out and all the compost removed. This compost should not be used again for growing mushrooms, but if it is saved it will make an excellent fertilizer for the garden and form also excellent potting soil for plants.

After all the compost has been removed from the mushroom beds the boards forming the walls of the beds and the floor of the beds should be thoroughly scrubbed with formalin. In scrubbing the boards make a solu-

tion using a pint of commercial formaldehyde to ten gallons of water. The boards and floor should be thoroughly scrubbed with this material. Formalin of this strength vaporizes readily and may cause considerable burning of the nose and throat and cause severe smarting of the eyes unless the cellar windows are thrown wide open in order to give thorough ventilation. It might perhaps be better to take the boards outdoors and do the scrubbing outdoors and then cover the boards with an old blanket or with sacks that have been soaked in this same formalin solution. In a day or two the formalin will evaporate and the boards may be stored for further use.

PICKING MUSHROOMS.—Mushrooms should be picked when the buttons have reached full size, but before the veil (the thin membrane covering the gills) breaks, as they are then heaviest. At this stage the mushroom should twist easily out of the soil and leave no stub or tear up the spawn. Mushrooms *should not be cut* off, leaving a stump in the bed as this is liable to start rots.

After the mushrooms are gathered the dirty butts may be cut off and placed in a separate receptacle from the mushrooms.

MARKETING MUSHROOMS

If mushrooms are grown in large quantities there should be no difficulty in securing a market through the agency of the produce commissions or wholesale houses. If the grower has sufficient experience to guarantee a regular supply he should be able to contract directly with the larger hotels and restaurants.

Small growers frequently experience trouble in disposing of their mushrooms. Those who grow mushrooms in small quantities should be able to dispose of them to local grocers or fruit stores or local restaurants. It is often possible to sell pounds to individuals who are fond of this delicacy.

Mushrooms should be gathered before the veil is broken. They should be carefully cleaned and the butts removed. Where only small amounts are grown they may be packed in berry boxes or in small baskets. Larger baskets up to 12-quart size are sometimes used. For special trade perforated cardboard boxes may be obtained. The mushrooms will continue to enlarge after they are picked so should not be tightly packed and should have plenty of air. If taken at the right time the mushrooms can be held a day or two at room temperature and may be held somewhat longer if kept in a cool place or in a refrigerator, but will deteriorate more quickly than fruit.

MARKET PRICES.—The market price varies greatly. Sometimes the price may be as low as 15 cents per pound and sometimes as high as a dollar per pound, so that a grower should not be disappointed if he receives

50 cents per pound. At less than 50 cents per pound there is little profit in growing mushrooms on a small scale.

MUSHROOM DISEASES AND PESTS

Mushrooms, like other plants, have many diseases, and are also troubled by insect and other pests. Other fungi attack them and cause deformities and damping off and crop failures. They are, also, the feeding and breeding grounds for insects and other animal organisms which destroy them.

FUNGUS DISEASES

MYCOGONE, LAMOLE OR BUBBLES.—This disease was first known in France many years ago and has since become distributed wherever mushrooms are grown in considerable quantity. The disease appears in at least two distinct forms. In our case the mushrooms are somewhat deformed, having swellings, tubercles and blisters and tumors on the cap, stipe and gills, but the fruit body retains the general form of a mushroom. This type is shown in figure 67. In the second form of the disease the mushrooms are so badly deformed that they scarcely look like mushrooms at all, but frequently look like mouldy, spongy puff balls, which become soft and decay before they mature. In very bad cases giant, abnormal structures occur.

This disease is caused by another fungus growing in the tissues of the mushroom. The fungus has been called *Mycogone perniciosa*. This fungus grows not only in the mushrooms themselves, but also upon the spawn and remains alive in the compost of the bed. Diseased mushrooms left on the beds scatter their spores all through the beds and through the

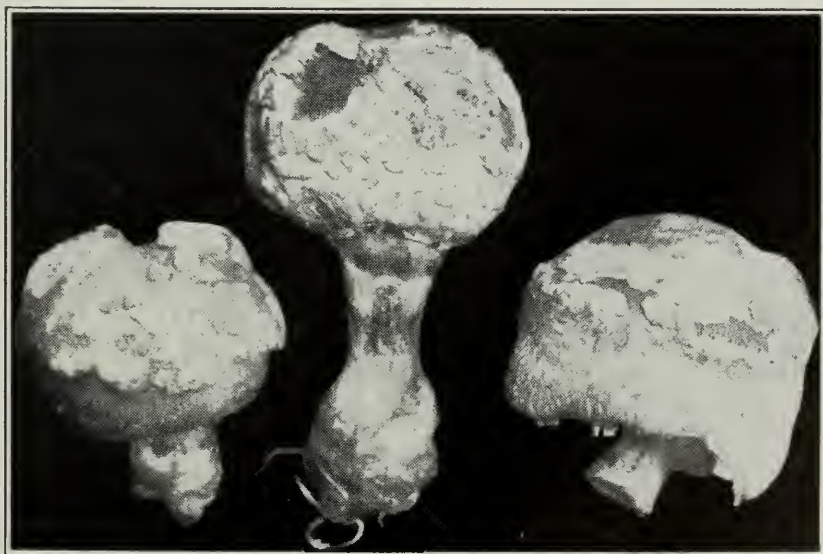


FIG. 67.—Mushrooms with Mycogone Disease.

house. These spores are quite hardy and remain alive for more than a year and under dry conditions, possibly several years.

REMEDIES.—Diseased mushrooms should be picked and placed in a paper bag and removed from the beds and then destroyed, preferably by burning. The diseased mushrooms should never be thrown out where they will contaminate the soil or manure that may be used in making beds. If the disease occurs in patches the casing soil should be removed and replaced by clean soil. The temperature of the beds should be lowered to 46° Fahrenheit for a few days then brought back to normal. Some advocate treating the contaminated areas with 2½ per cent. solution of lysol.

FUMIGATION WITH FORMALDEHYDE

After the crop is taken off all compost should be removed and the beds thoroughly cleaned. All remains of the crop, including compost, should be removed and so disposed of that none of it will be brought back in making new compost. The boards forming the walls of the beds and also the walls and the cellar should be thoroughly scrubbed with strong formalin solution. The cellar should also be fumigated with formaldehyde gas fumigation. Before another mushroom crop is put in, the cellar or mushroom house should be made as airtight as possible by pasting paper over all the cracks. It should then be fumigated as follows: For every 1,000 cubic feet of space take three pints of commercial formalin and one and a half pounds of permanganate of potash. Earthen jars or crocks of one gallon capacity should then be distributed evenly through the cellar. In each vessel place a pint of commercial formalin. Place the permanganate of potash in paper sacks, each containing half a pound of the permanganate. Beginning at the point farthest from the door, drop a bag of permanganate in each jar containing formalin and proceed towards the door. Then close and carefully seal the door to make it airtight. The permanganate of potash and formalin react and dense, very irritating fumes are given off.

Keep the cellar or mushroom house closed for at least twenty-four hours, then open all the windows and doors and thoroughly ventilate the cellar. Be careful that no lighted lamp comes near the house as the gas is explosive.

FUMIGATION WITH SULPHUR

As a control for both disease and insect pests, fumigation with sulphur is highly recommended. For the details in sulphur fumigation see the section written by Professor Caesar on control of insects, page 68.

INK CAPS, FALSE MUSHROOMS (*Mushroom Weed*).—In some cases after the beds are made there will be a development of many small, slender mushrooms that melt down into an inky liquid. These are wild mushrooms called Ink Caps. These wild mushrooms of themselves are not harmful but indicate that the manure was not properly fermented. The wild mushrooms should be carefully gathered and removed so that the decaying parts will not become a starting point for diseases.

MOULDS

Sometimes the surface of the beds becomes covered with white, brown, or blue moulds. These are usually the result of using either under-composted manure or using contaminated soil for casing.

If these are serious, treat the same as for Bubbles or *Mycogone* disease.

FOGGING OFF

Very often buttons start to form on the spawn and after growing to the size of a pea or a little larger, they turn brown and become soft and decay. This may, sometimes, be due to attacks of mites or mushroom flies if any evidence of these little animals can be found. In many cases fogging off is due to attacks by bacteria. Where this is the case no evidence of larvae or worms can be seen.

REMEDY.—The diseased mushrooms should be collected and destroyed. The temperature should be brought down to 54 to 58 degrees. Good ventilation is also necessary and the bed should be allowed to become drier. After the crop is off, treat as for *Mycogone* or Bubbles.

SPOTS OR STAIN

A Bacterial Disease.

This disease appears as brown spots or blotches on the surface of the mushroom. The spots may be small and scattered or may cover nearly the whole surface. The disease is encouraged by a film of moisture on the cap of the mushroom. This condition arises when the humidity is high, either from too much watering or poor ventilation. Very generally the temperature is also too high. The disease may be spread in working with the mushrooms and it may also be spread by insects.

CONTROL.—Great care should be taken in watering the beds not to wet the mushrooms. Good ventilation will tend to keep the surface dry. Temperature should be held at 55° and insects should be controlled. Mushrooms that are diseased should be removed and destroyed.

MUSHROOM INSECTS AND THEIR CONTROL

By L. CAESAR

Provincial Entomologist.

There are three common troublesome insects which attack mushrooms. These are the mushroom maggot, mushroom mite, and springtails. The following preventive measures are very important in the case of all three.

PREVENTIVE MEASURES

(1) To make as sure as possible that there will be no mites or insects in the house, it is well always to fumigate it, while empty, just before filling. Use 5 lbs. of sulphur to 1,000 cu. ft. of space. If the house is large, use several pans and distribute them at regular intervals through the building. The building should first be made as nearly airtight as possible. Allow fumigation to continue for 10 hours, and have a couple of fans running to distribute the fumes. *Caution:* Use large pans for the sulphur lest it boil over and cause fire, and remember that if there are mushrooms or other plants in an adjoining house, the fumes may pass through into it and destroy these.

(2) Old or waste mushrooms should never be left in piles in the house, but should always be removed and burned. An easy way to do this is to pour waste crank case oil over them and set fire to it, or they may be covered with quick-lime.

(3) Used or waste manure should not be left near by, but hauled to a distance and scattered thinly over the ground to let it dry out quickly, or it should be plowed under. This is because insects often breed in such manure.

(4) The ground to be used for composting outdoors should be scraped clean and well drained before any manure is piled on it.

(5) The manure should be well composted, and at each turning the outside part should be turned to the inside. This is because the heat there will kill the insects that have been driven by it to the surface.

(6) In filling the house, run the manure in rapidly to maintain heat, and, when the beds are full, close the house. The manure then should heat rapidly and reach 135° Fahrenheit or higher. This will kill most of the insects and mites in the manure, or drive them to the surface.

(7) When the manure is at its highest, say about 135° Fahrenheit, fumigate with 1½ or not more than 2 lbs. of sulphur to 1,000 cu. ft. of space for 5 or 6 hours. This will kill the mites that the heat has driven to the surface of the manure. Be careful this time also that fire does not

start from the burning sulphur. A fan and the uniform distribution of the pans are again desirable to keep the fumes well spread through the house.

(8) After this fumigation, the doors, windows and ventilators should be screened with a 30 mesh copper screen to keep out insects. If copper cannot be purchased, use a fine cloth.

MUSHROOM MAGGOT.—These are tiny white maggots which bore into the stem and cap and leave a brown trail wherever they go. They quickly make the plants unfit for use, and are usually the most common and injurious mushroom species. The adults are little dark-coloured two-winged flies, much smaller than mosquitoes. The flies lay their eggs either on the mushrooms or in the soil beside them. These soon hatch and the maggots almost at once attack the plants and become full-grown in a few days. They then pupate in the soil, and in a few more days the new flies emerge. As each female is capable of laying 1,000 eggs, these insects can increase at a remarkable rate, and often, when not combated, ruin the crop.

CONTROL.—The preventive measures outlined above are very important in the control of this insect, but if they have not been carried out, or, if in spite of them, maggots are found to be present, there are several methods of control which may be used. Of these the best seems to be to dust the house with finely powdered pyrethrum, or with one of the commercial dusts containing a definite amount of pyrethrum along with a carrier such as talc or gypsum. These are often more effective than pyrethrum alone. Four ounces of the dust should be used to every 1,000 cu. ft. of space. It should be applied by a small hand duster. If the flies are abundant, dust every day for a week, then dust every third day until they disappear. By killing the flies, egg-laying is prevented. Pyrethrum dust very rarely does any damage to mushrooms or to the mycelium. It is also harmless to human beings, whether inhaled or eaten.

Another helpful method of control is to use lights to attract the flies. Place an electric light on the ceiling above each end of the central aisle of the house. Suspend a flat pan containing about one-half inch of kerosene from 6 to 12 inches below each light. The light attracts the flies and many of them get into the pan and are killed. Tanglefoot papers may be used instead of the pan and oil. These are simply hung up around the light.

If a glass is put into the windows or door, the light through it will also attract the flies. Tanglefoot may be put alongside the lights or may be smeared here and there over the glass, and will capture numerous flies. When nearly covered with these, they can be scraped off and fresh tanglefoot put on, if necessary.

If the house is kept at a temperature of 55° F., it will help greatly to lessen the increase of these and other insects, but when fumigating with sulphur at the times mentioned above, or dusting with pyrethrum, better results are obtained if the temperature is raised to 65° F.

MUSHROOM MITES.—These are very small white mites, not as large as the head of an ordinary pin, yet visible to the naked eye. They have a glossy body and four pairs of legs. They lay small white eggs in the mushrooms, or in the soil. When present in large numbers, they are very destructive and eat out large areas in the mushrooms. Fortunately many houses are free of them. If present, they are usually to be seen easily on the surface of the manure when it is heating, because the heat drives them from the interior. There are often other mites present in the beds, which are brown in colour. These do practically no damage.

CONTROL.—Once more the preventive measures recommended at the beginning of this discussion are very important, especially the fumigation with sulphur to kill the mites in the manure. Some years ago the writer suggested to the owner of a very badly infested house that he try scattering paradichlorobenzine over the beds. This was done and gave excellent results. Since then several other growers have used the same method and all reported satisfactory control without any serious damage. Before treating a bed for mites, the mushrooms above the ground should be removed, because the paradichlorobenzine, if it touches them, will cause injury. The bed should be covered with cheesecloth and paradichlorobenzine scattered as uniformly as possible over it, at the rate of 1 lb. to 200 sq. ft. of surface. Leave this until it has all evaporated and then remove the cloth. Several growers have applied the paradichlorobenzine directly to the soil, but the above method seems the safer.

SPRINGTAILS.—These are very small wingless insects. As the name indicates, they have the power of leaping as a result of a small spring-like structure beneath the hind part of the body. There are several species of them. Some are white, others grey, and others nearly black. At times they collect in piles consisting of thousands of individuals. These piles usually occur in the aisles. Springtails feed upon the spawn and mycelium, as well as on the mushrooms themselves. Out of the latter they chew pieces. Injury is usually found in the bottom beds. As a rule, however, springtails are not nearly so common or troublesome as the mushroom maggots. They are generally brought into the house in the manure and then multiply.

CONTROL.—Just as in the case of the mushroom maggots and mites, preventive measures as outlined above are very helpful in keeping the springtails out of the house. If, however, they are present, they may be

controlled by dusting them thoroughly with a 3% nicotine dust. This can be obtained ready mixed from the large spray companies. Pyrethrum dust helps to some extent, but is not nearly so effective as nicotine. Nicofume pressure fumigators may also be used, and are said to be very satisfactory. These come in small cans. The directions for use are given on the cans. Humidity in the house at the time of application should be high. This can be obtained by sprinkling the walks or beds with water.

Paradichlorobenzine crystals scattered at the rate of 1 lb. to 200 sq. ft. of surface over cheesecloth, as described under mushroom mites, will control some species satisfactorily.

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The Cultivated Mushroom.—Bureau of Mushroom Industry, Chicago, Ill.

Most Seed Companies supply pamphlets on Mushroom Growing.

RECIPES FOR USING MUSHROOMS

1. *To Can Mushrooms.*

Sometimes more mushrooms are gathered at one time than can be used immediately. These cannot be kept like vegetables, but may be preserved by canning.

Peel, dry, wash thoroughly and boil in well-salted water until done. The very tender kinds, such as ink caps, require little boiling. The tougher kinds may be boiled for an hour. Morels and puff balls should be cut into small pieces. Be sure to salt abundantly and have boiling hot when put into the glass jars, then seal as for any canned fruit or vegetable.—*Benedict.*

2. *Mushrooms May Be Dried.*

Take those neither very young nor very old. Remove the butts. Then slice and string or skewer lightly and expose to a current of warm, dry air. A warm oven with the door open is a good place. When quite dry and shrivelled, pack in tins with spice at the top and bottom. When wanted for use soak in tepid water for some hours, then cook.—*Hay.*

3. *Soup.*

One quart mushrooms
Three pints water
Half pint milk
One tablespoon flour

Two tablespoons butter
One dessertspoon salt
One teaspoon pepper

Carefully clean the mushrooms. Put in a covered boiler with water, and boil slowly for an hour. Put through a colander. Reject that which does not pass through. Add milk thickened with flour, butter, salt and pepper. Bring to a boil. Serve. This makes two quarts of soup.—*McIlvaine.*

4. *Stewed Mushrooms.*

Cut into small pieces of even size, place in a covered saucepan. To each pint add two tablespoons of butter. There will be enough water from washing to make liquor. Stew slowly twenty minutes; season to taste with pepper and salt. May be served either alone or on toast.

The tougher kinds should be soaked in warm water half an hour before stewing. Parsley, nutmeg or beef gravy may be added.

5. *Fried Mushrooms.*

One pint mushrooms caps
One teaspoon salt

Half teaspoon black pepper
Two tablespoons butter

Put the mushrooms into boiling hot butter and fry ten minutes. Add a little milk or cream thickened with flour. May be served alone or on toast.

6. *Baked Mushrooms.*

Wash, place the caps in a tightly-covered dish or pan, after dipping them in bread crumbs. Arrange in layers with a small piece of butter on each mushroom, with a little pepper and salt. Bake from twenty to forty minutes until done. Serve on toast. Cheese grated on each layer makes a desirable addition.—*McIlvaine.*

7. *Scalloped Mushrooms.*

Put in a baking dish layers of cold cooked meat, diced or sliced. (Stewed until tender.) Moisten with gravy or sauce. Alternate with stewed mushrooms. Cover with buttered biscuit or bread crumbs. Bake about twenty minutes.

8. *Salads.*

Many kinds of mushrooms make good salads. The shaggy mane, ink cap and many of the coral fungi are good raw. The tougher kinds should be first stewed, then drained and cooled.

Mix with mayonnaise dressing or make a dressing to taste of oil, vinegar, salt and pepper. Serve on lettuce.

9. *Fresh Mushroom Sauce.*

Two tablespoons butter
Two cups freshly prepared mushrooms
Salt and pepper

Put butter in a granite or porcelain-lined saucepan. When hot add mushrooms. Cover closely and cook briskly two or three minutes. Season to taste with salt and pepper, and serve with broiled beefsteak, birds or sweetbreads.—*Mr. E. B. Irving.*

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Farm Water Supply

— BY —

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ONTARIO AGRICULTURAL COLLEGE

GUELPH, ONTARIO



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The Farm Water Supply

. . . BY . . .

R. R. GRAHAM, B.A., B.S.A.

THE VALUE OF MODERN CONVENIENCES IN THE FARM HOME

Running water or "water on tap," sinks, bathrooms, etc., have been associated with town and city homes as far back as we can remember. These conveniences have been found necessary in such dense centres of population, in order to prevent disease epidemics, and maintain a good standard of health, and the results have been exceedingly satisfactory. From this standpoint they are not so necessary in the rural districts, but their use would help very much to protect the wells on the premises, and



A splendid type of Farm Home with attractive surroundings, and fully equipped with pressure water system and bathroom in house, and water in stables supplied by windmill on well.

hence improve the quality of water used in the home, and besides they would give added comfort and convenience to the family, and materially reduce labor and save much time in the ordinary daily work about the farm plant. There is probably no equipment on the farm that raises the standard of living there so much as a *water system* and *bathroom*. Take note of the following statements of one of our Ontario farmers speaking from experience on this question: "*Our water system, more than any other improvement that we have made around the place, gives us unending satisfaction and has robbed the city home of what was once its leading*

NOTE:—Consult Bulletin on "Plumbing and Sewage Disposal Systems for the Farm Home."

point of superiority. Not only have we found it quite possible to have running water, hot and cold, in a farm home, but the installation is less expensive than it is in the city. And what a comfort is a bathroom! I enjoy it to the full. I would not be without it if the cost were twice as great. The women folks are the chief beneficiaries. No more longing for the comforts of the city home! They have them right on the farm. I do not anticipate that the women will be instrumental in furthering rural depopulation, for, if all reports be true, rural women who live without city conveniences have a habit of sowing seeds of discontent and taking the whole family off to town."

TWO INDISPENSABLE FEATURES OF WATER SUPPLIES

(1) They should be plentiful enough to meet every possible farm need for water, and more.

(2) They should be wholesome and pure in quality.

As to the first, there is sufficient evidence to show that many farms are inadequately supplied with water. In many cases of poor supply the only real remedy is the sinking of deep or rock wells. Particularly imperative is this in cases where water systems and bathrooms are contemplated, as much more water will be needed when these conveniences are installed than before. Deep well water is much superior in quality, and it is colder than surface supplies, and therefore more effective for cooling milk at the farm. Such supplies are usually not affected by periods of drought.

Speaking of the quality, it is quite evident by an inspection of chart shown in Fig. 1 that there is a great need for improvement in this respect as well. Better well location and construction (see pages 5 to 9), use of deeper wells and keeping the surroundings of wells as clean as possible, will all contribute much toward better water supplies in the country.

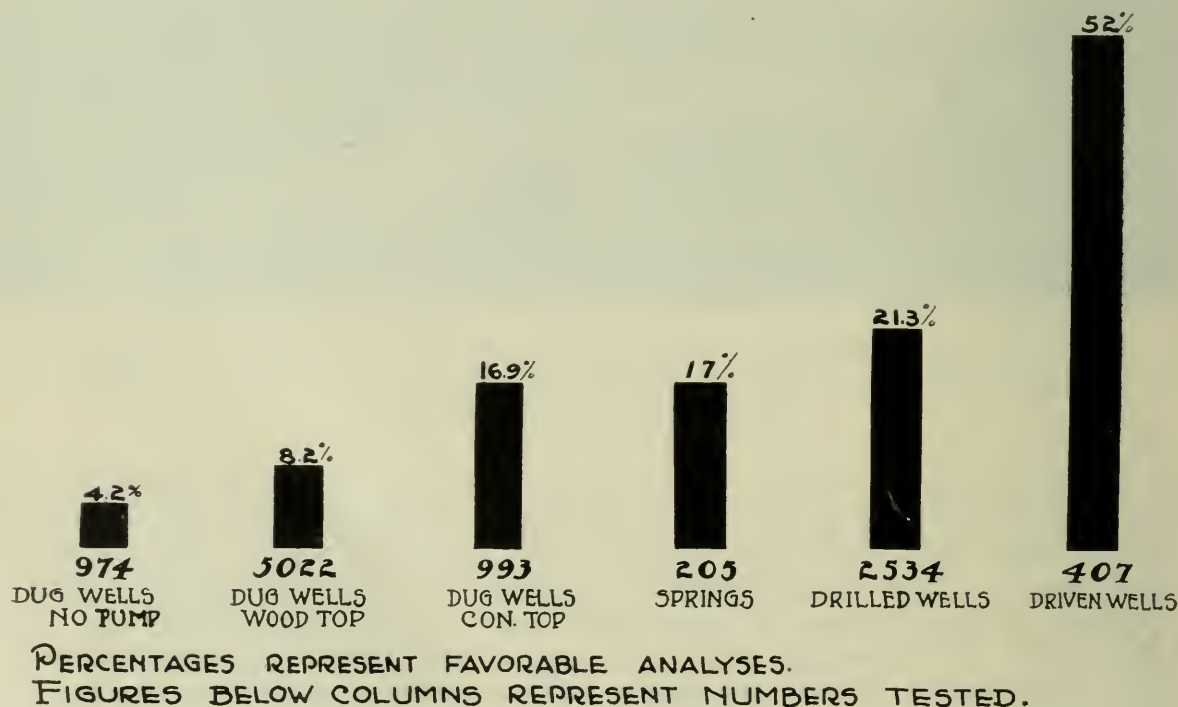


Fig. 1—Wells of various types and percentages in each group giving favourable analysis.

(By courtesy of the Provincial Board of Health)

SOME AIDS TO FINDING UNDERGROUND WATER SUPPLIES

(1) Careful investigation of existing wells in the locality.

(2) Access to logs of wells sunk in the district.

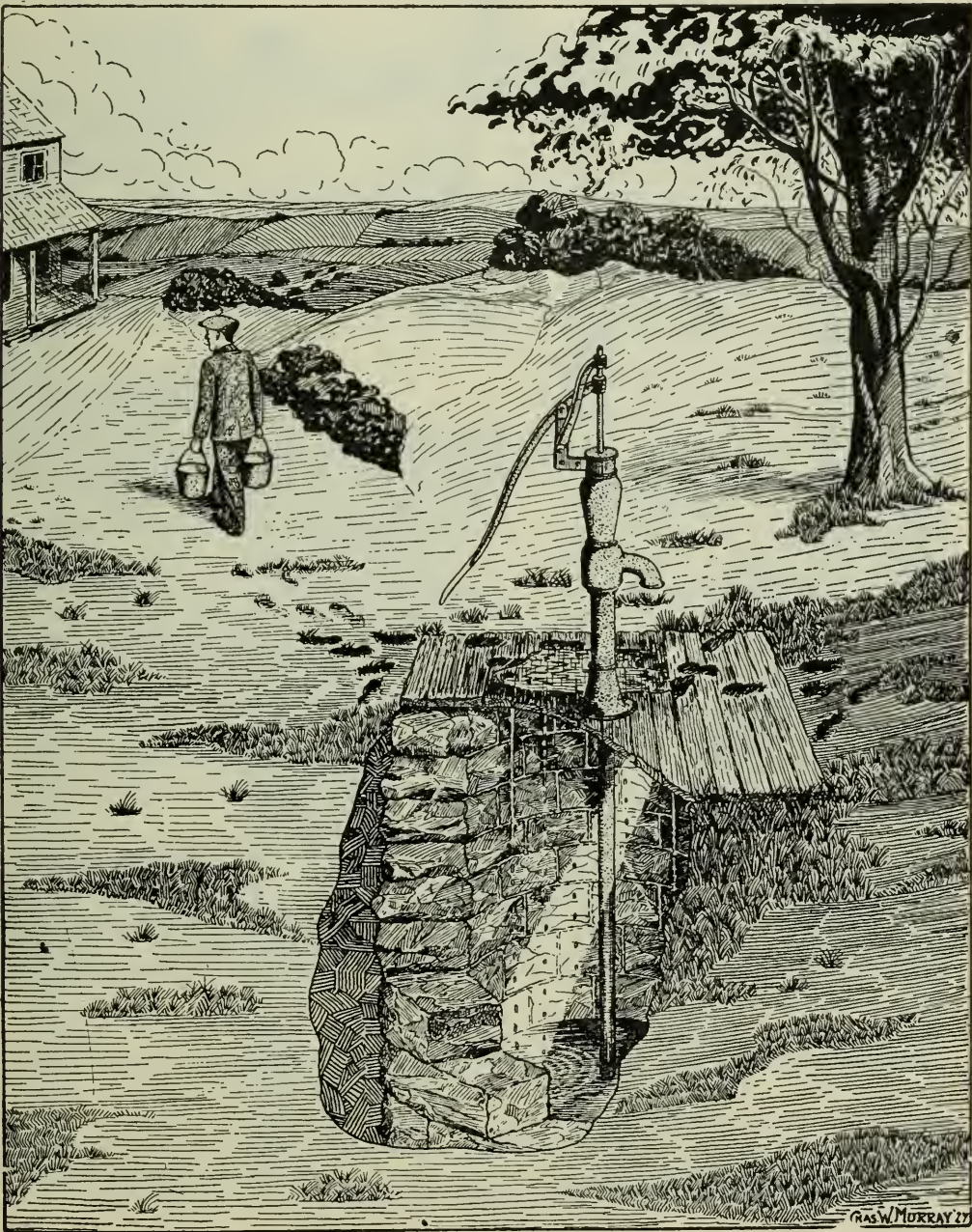
(Write Department of Mines, Parliament Buildings, Toronto.)

NOTE:—A well log is a well driller's report on soils and rocks passed through in drilling a well, and depth at which water, if any, was struck.

(3) Getting as much information as possible on the geology of the particular district, and also on the water-bearing capacity of various soils and rocks.

(Write Department of Geology, Ottawa, Ontario.)

(4) Water Diviners.—Certain individuals make great claims for ability to locate underground supplies, but scientists as a class are somewhat

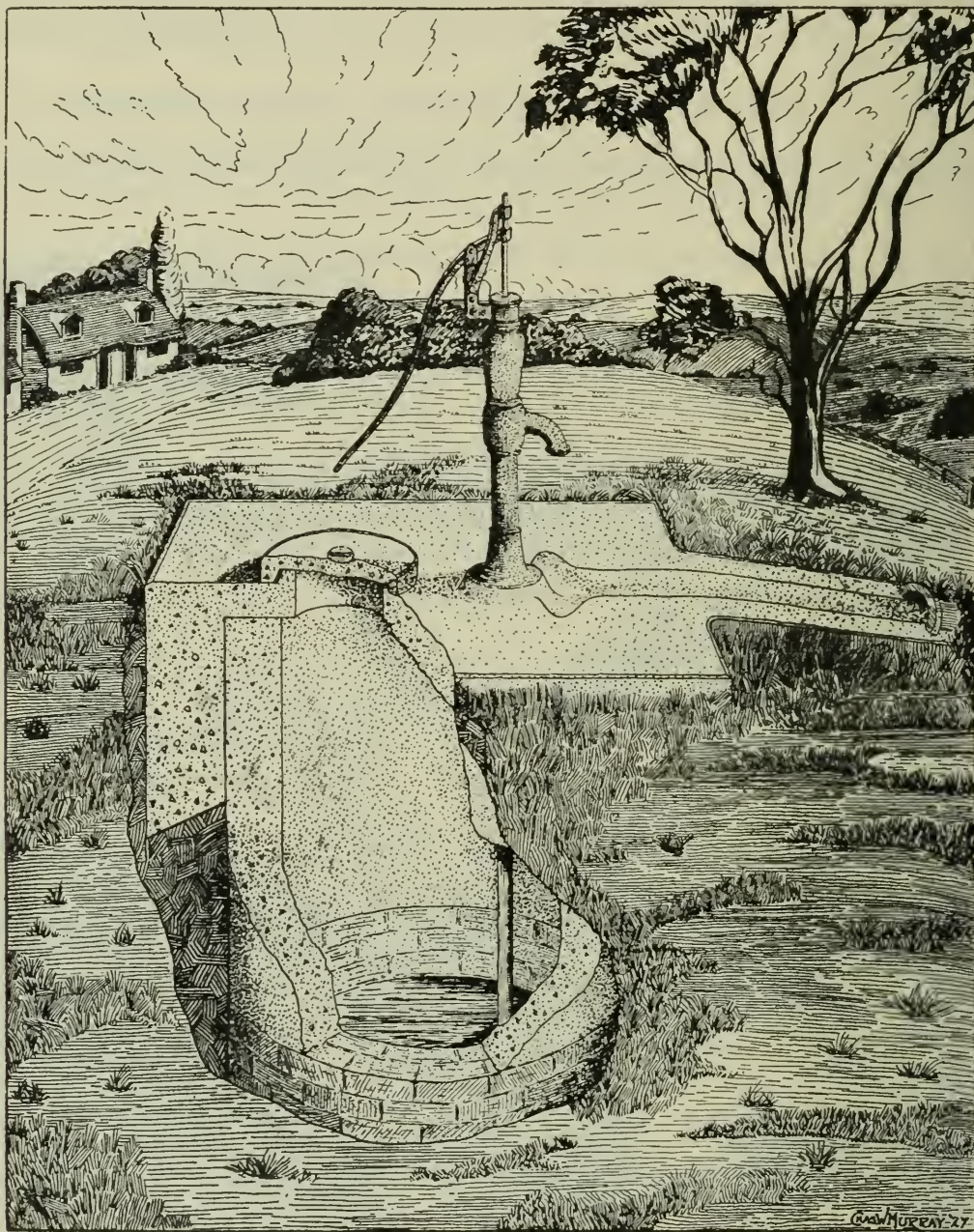


AN UNSANITARY WELL

This enables filth of all kinds to gain direct and easy entrance to the drinking water.

sceptical of their claims, and in most cases the application of the forked twig or other gadget does not produce much better results, if any, than the use of common sense.

Fuller, in his book on "Domestic Water Supplies," sums up pretty well the opinion of scientists on this question of finding water by the statement: "So far the only scientific basis for locating water is a knowledge of the laws of occurrence and movements of the ground water, for on these factors depend the quantity, quality and safety of the supply."



A SANITARY WELL

Water-tight top and sides exclude surface drainage and other filth.
(By courtesy of the Provincial Board of Health)

TYPES OF WELLS

Wells are classified usually as *dug*, *drilled*, *driven*, and *bored*.

(a) THE DUG WELL

When the ground water occurs in soils or loose materials that can be excavated by pick and shovel, and within a reasonable depth, the dug or

shallow well is the common type. Since the ground water seeps through soils very slowly, particularly the clays, the dug wells have to be made 5 or 6 feet wide in order to provide sufficient seepage area to let enough water into the well and provide storage. As a rule, they vary in depth from 10 to 100 feet, in rare cases deeper. Figs. 2, 3 and 4 illustrate typical dug wells and how they should be cribbed and covered.

Many shallow wells go dry in time of droughts, or permanently fail, owing to scarcity of water in the soil. In some cases it pays to dig them deeper or else bore or drive in the bottom of them until water is struck. If bored, it would be necessary to insert a casing in the dry hole and bring it up slightly above the bottom of the pit in order to keep out contamination that might enter the dry well. See Fig. 3 (b).

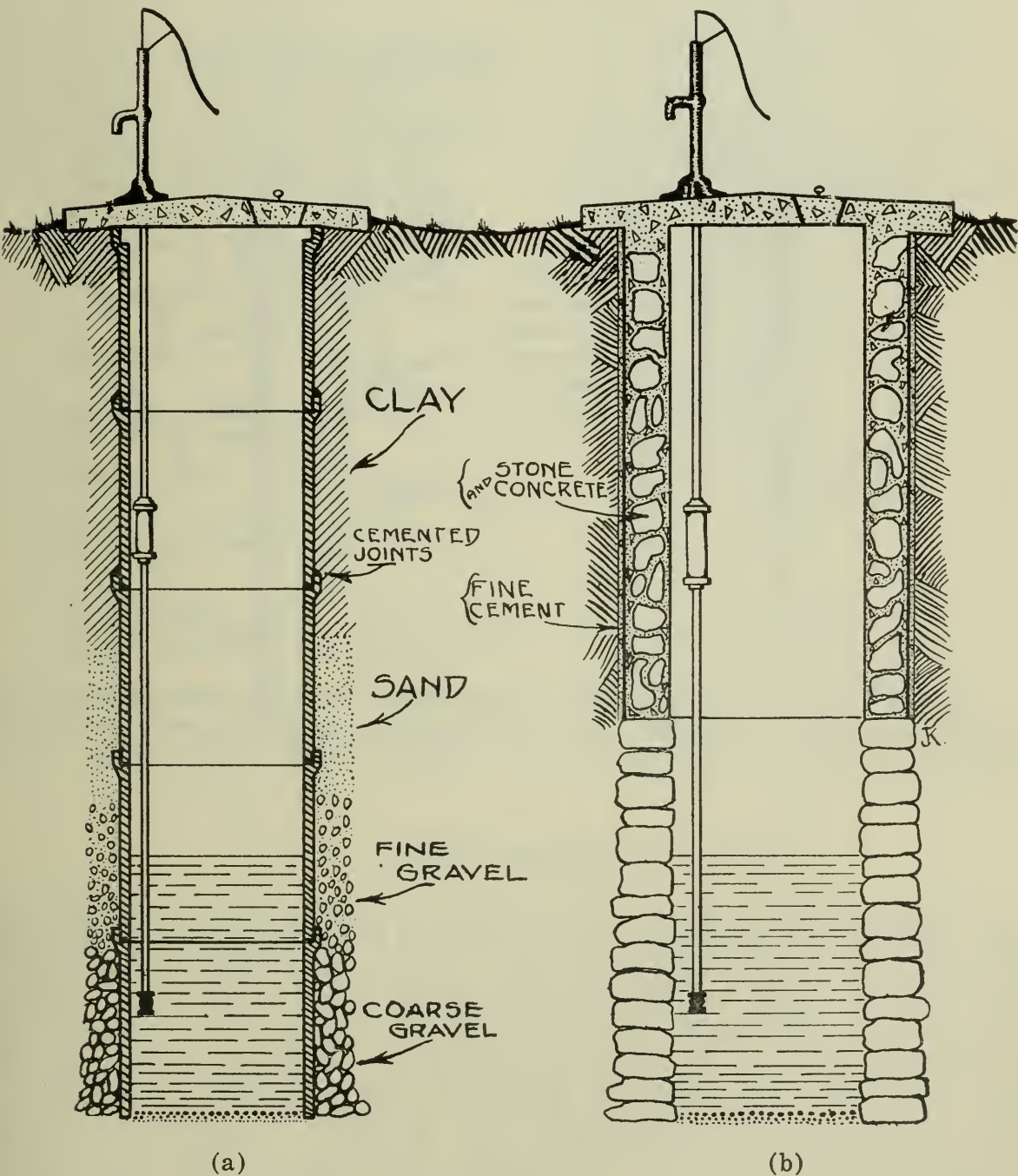


Fig. 2.—(a) Dug well cribbed with cement tile.
(b) An old stoned well rebuilt with water-tight top,
and sides 8 to 10 ft. deep.

(b) THE DRILLED WELL

This is the deep type of well sunk through soil or rock formation by a special tool or machine operated by a well driller. Water may be struck at various depths, frequently from 60 to 200 feet, but sometimes much greater depths are required. Since the water comes from such low levels, it is likely to be pure and wholesome. The quantity is variable, depending on the nature of the water-bearing strata that are tapped. The size of the hole varies from three to six inches for farm wells and much larger for municipal wells. The bore is protected with a water-tight wrought-iron casing, which should be driven firmly into the rock for a few feet at least to exclude surface water.

The contract for boring a well is usually made on the basis of so much per foot, which price includes casing and testing for water, etc.

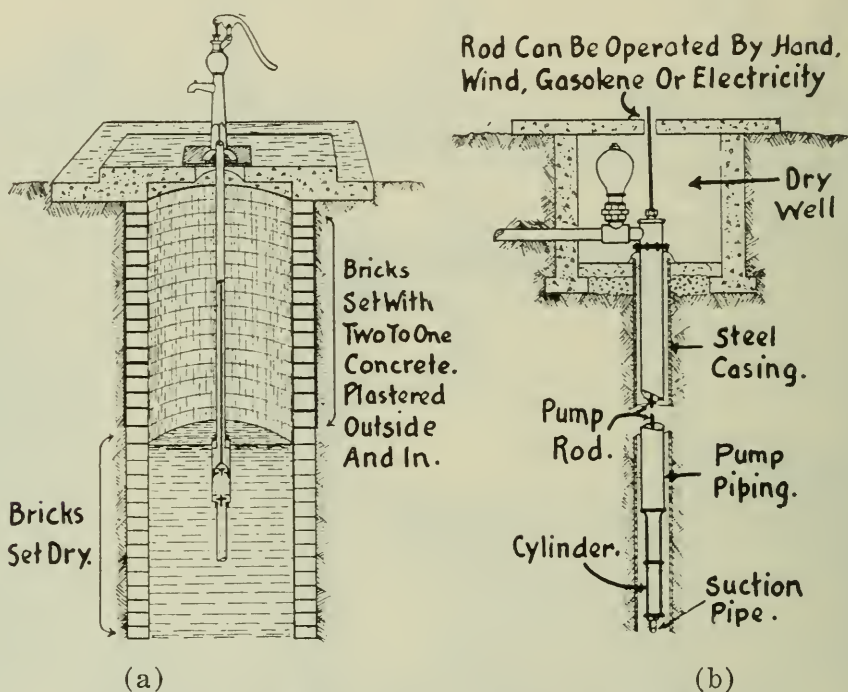


Fig. 3.—Two types of deep wells, brick and bored.

The drilled well is one of our best and most reliable wells and is very common in certain areas, and promises to become more common and widespread in the future. Various drilled wells are illustrated in Figs. 3(b) and 4(a).

(c) DRIVEN WELLS

Where a water-bearing layer of sand or gravel exists within 20 feet of the surface, as on lake shores, and the soil material above it is not too hard or stoney, a drive-point (see Fig. 5) may be forced down to the water, which can be pumped up to the surface, as illustrated in Fig. 4(b). Drive-points vary in diameter from $1\frac{1}{4}$ to 2 inches, but $1\frac{1}{4}$ and $1\frac{1}{2}$ -inch sizes are the common ones. The length is $2\frac{1}{2}$ feet and the brass screen over pipe varies from Nos. 90 to 60 mesh, depending upon coarseness or fineness of sand. The flush iron point shown in Fig. 5 is used only in quicksand below a deep well cylinder, illustrated in Fig. 20. A maul or wooden drop weight of some kind may be used to force the drive-point into the soil; sometimes a small auger may be necessary to assist in sinking the point. The point must be driven in a perpendicular fashion and pipe added as the driving pro-

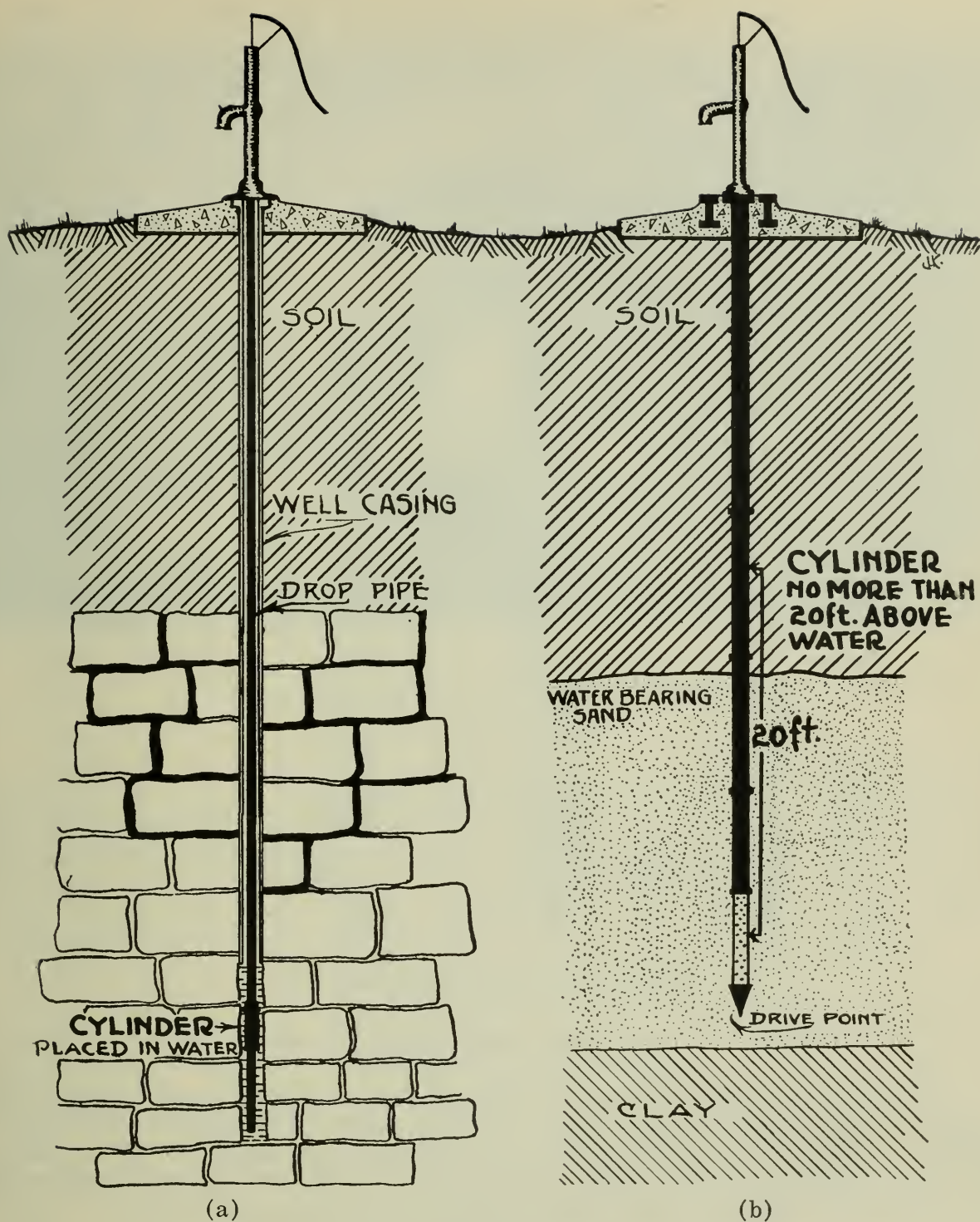


Fig. 4.—(a) Drilled well properly protected.
(b) Driven well properly protected.

ceeds, the driving cap always being used on the upper end of the line. Tests for water may be made by a plumb bob dropped down the pipe or by pump. If the water-bearing layer proves to be satisfactory, and a lot of water is required, several points may be sunk and connected together above ground, one pump being used on the multiple system. The drive-point may be driven from the bottom of an old dug well if a water-bearing layer of sand is within 20 feet of the bottom. In this case the pump cylinder must be put near the bottom of the old well. The quality of the water obtained from driven wells is good (see chart, Fig. 1). The filter may be removed if choked.

Quicksand may occur in rock wells if it exists above the rock, and

when there is a crack in the casing at a point near the surface of the rock, or when the casing does not fit tightly enough in the rock to prevent the quicksand getting down. Driving the casing down or repairing a leaky section may remedy the trouble.

Drive-points may become choked badly if quicksand is very fine. Removal and cleaning may give temporary relief, but usually there is no permanent cure in such cases.

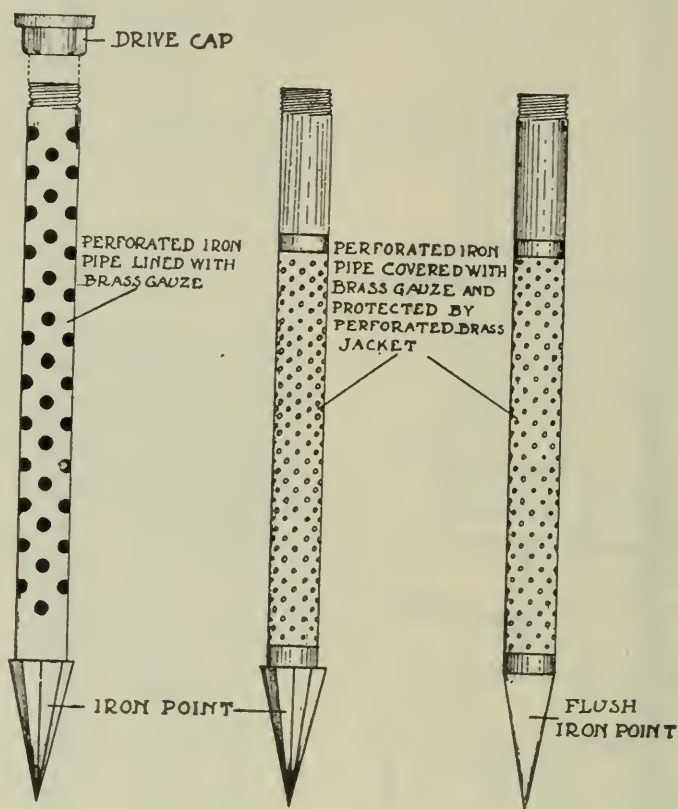


Fig. 5.—Types of well points.

(c) THE BORED WELL

In instances where the soil is quite loose and free from stones and boulders, and where a good water-bearing layer of material lies within twenty or thirty feet of the surface, at any rate not exceeding fifty feet, the well or hole may be sunk by an auger, if hole is two or three inches in diameter, or by a special soil auger or well borer for larger holes.

In the small-sized ones the hole is not big enough to admit a cylinder, and consequently the water must lie within the suction distance, say, twenty to twenty-five feet from the surface, where the cylinder must of necessity be located.

The smaller wells are cased with iron pipe $1\frac{1}{2}$ to 2 inches in diameter and the larger ones with wooden casings or cement tile. The casings should be forced to a depth a little lower than the water level, and if soil at the bottom of the hole is not loose or gravelly the lower portion of the casing should be perforated to facilitate ingress of water. If quicksand or very fine material is encountered, a drive-point or screened pipe may have to be attached to the lower end of the suction pipe. If coarse gravel is dropped around this filter or screen it will often be beneficial in preventing clogging of the pipe by entrance of sand.



Fig. 6.—This abundant spring is piped to the farm buildings many hundred feet distant, the water flowing there by gravity.

SPRINGS

Next in importance to wells as a source of water supply are the springs. In certain areas the geological formation is very favourable to the occurrence of springs, in others it is quite the reverse. Springs vary in respect to mode of origin, manner of emergence, in size, depth of origin and the nature of the water. Springs, as a rule, produce the purest and most wholesome water we have, and a large share of them yield a lot of water the year round, and never fail even in the severest droughts.

The service rendered by springs depends upon their capacities, and their elevation and location in respect to the farm buildings. If a good spring is located reasonably close to the home and on higher ground, the water may be supplied by gravity to the buildings, as shown in Fig. 18, or if on lower ground it may be pumped up by the hydraulic ram, as described and illustrated on pages 31 to 36, or if the spring be close to the buildings the water may be carried or pumped into the buildings. Again, if springs are located in the pasture land they afford excellent watering-places for the stock during the pasturage season or may be even in the winter time if they are not too far away.

If springs are to be used as regular supplies of water, it is worth while to improve and protect them by cleaning out and probably deepening the basin, cribbing them and putting on a lid or top to exclude foreign matter, as illustrated in Fig. 23.

FARM CISTERNS

1. *The Need.*

There are some very good reasons for the use of cisterns on our farms:

- (1) To supplement the supply of well water at both house and stables. Our rainfall is quite ample and uniformly distributed throughout the seasons, amounting on the average to about $21\frac{1}{2}$ inches per month, to ensure a plentiful supply of soft water at all times if sufficient storage be provided.

- (2) The soft water is definitely much superior to hard water for washing clothes and bathing purposes—two big items on the farm.
- (3) For those who have a pressure water system and plumbing it is possible with a small extra expense to have the soft water, both cold and hot, on tap as well as the hard water. Many farmers are putting in this convenience today, and they are well pleased with it.
- (4) By using soft water through the range boiler for the hot water supply instead of the hard water, a great deal of trouble and expense can be avoided because the heating coil in the furnace or the water front in the kitchen range will not become choked with lime as is the case frequently with hard water.
- (5) Where hard water is very scarce or very poor in quality, soft water has to be used for drinking and cooking purposes. In such cases it should be filtered and sterilized by boiling.

2. *How to estimate the quantity of soft water that can be collected from a given size of house or other building.*

Take the product of the length and width and multiply this by the rainfall in terms of feet, then multiply the result by $6\frac{1}{4}$ (Imperial gallons in 1 cubic foot), $\frac{3}{4}$ of this final product will give approximately in gallons collected, $\frac{1}{4}$ being wasted in one way or another.

As an example, a house 40 feet square would catch:

$$\begin{array}{r} 1 \quad 1,600 \quad 25 \quad 3 \\ -x \quad \quad x \quad -x \quad - \end{array} \left. \vphantom{\begin{array}{r} 1 \quad 1,600 \quad 25 \quad 3 \\ -x \quad \quad x \quad -x \quad - \end{array}} \right\} = 1,250 \text{ gallons for a rainfall of 2 inches.}$$

3. *Size and Capacity.* Three factors largely will determine this.

(1) Size of the family; (2) Quantity of soft water used; (3) The roof area of the buildings. As a rule cisterns are too small. The following sizes may serve as a useful guide.

<i>Shape and Dimensions</i>	<i>Capacities in Imperial Gals.</i>	<i>Suitability</i>
A.		
Square - - - - - 5' x 5' x 5'	780 gals. or 24 bbls.	Small family (2 to 4) using water sparingly at kitchen pump.
or Rectangular - - - - - 6' x 4' x 5'		
or Round - . 5 $\frac{2}{3}$ ' diameter and 5' deep		
B.		
Square - - - - - 6' x 6' x 5'	1125 gals. or 35 bbls.	Medium size family (5 or 6) using water sparingly at the kitchen pump.
or Rectangular - - - - - 8 $\frac{1}{2}$ ' x 4' x 5'		
or Round - - - - - 6 $\frac{3}{4}$ ' dia. x 5'		
C.		
Square - - - - - 8' x 8' x 6'	2400 gals. or 76 bbls.	Small family using hot and cold water in kitchen and bathroom with pressure system.
or Rectangular - - - - - 11' x 6' x 6'		
or Round - - - 9' dia. and 6' deep		
D.		
Square - - - - - 10' x 10' x 6'	3750 gals. or 119 bbls.	Medium size family using water cold and hot in kitchen and bathroom.
or Rectangular - - - 12' x 8 $\frac{1}{3}$ ' x 6'		
or Round - - - 11 $\frac{1}{3}$ ' dia. and 6' deep		

NOTE:—A very large family would require a cistern holding at least 50% more water than the last one listed, a size 10' x 10' x 8' or 12' x 8 $\frac{1}{3}$ ' x 8'.

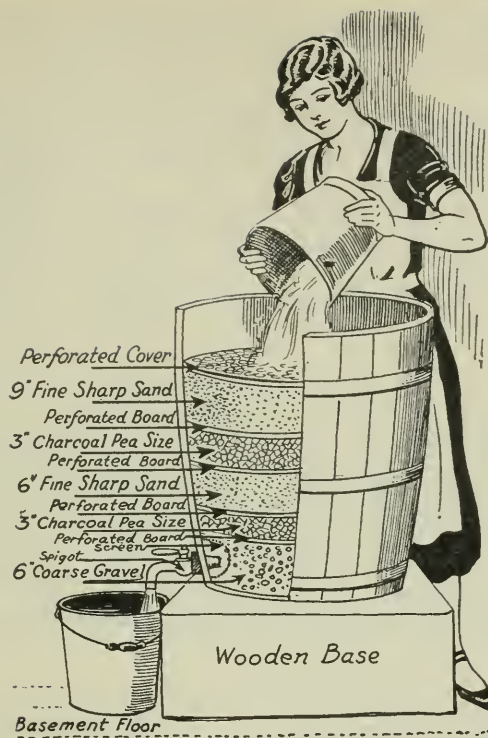


Fig. 7.—Suggestion for simple filter to make soft or cistern water usable.

4. Construction.

Usually cisterns are constructed of concrete and give satisfaction if well built. Any one of the three shapes mentioned may be used, but the round is the most economical so far as materials are concerned and is less liable to crack, but more labor is entailed in building forms. Brick is often used for the round ones.

If one be not experienced in concrete work of this kind, he would be well advised to secure the services of a concrete contractor since a good job in this case is very important.

The amateur builder may find the following information helpful:

- (1) The sand and gravel should be free from dirt or loam.
- (2) A 1-2-4 mix is best
- (3) 6" to 8" wall thickness is sufficient.
- (4) Materials should be thoroughly mixed before and after the water is applied, especially "before," to secure a uniform mixture.
- (5) Reinforcement rods $\frac{3}{8}$ " diameter should be used both vertical and horizontal, at intervals of $1\frac{1}{2}$ to 2 feet, and all joints and junctions should be well lapped and tied with wire.
- (6) The whole interior surface should be covered with a rich cement plaster 1 to 2 to prevent seepage.
- (7) A 1-2-4 mix will require per cubic yard of mixed concrete 6 sacks of cement, 12 cubic feet of sand and 24 cubic feet of pebbles or stones.
- (8) Using the rectangular shape, the quantities of materials for the A, B, C and D sizes of cisterns listed above are as follows:

For A size—15 sacks of cement, 30 cubic feet (1.1 cubic yards) of sand and 60 cubic feet (2.3 cubic yards) of stone.

For B size—21 sacks of cement, 42 cubic feet (1.5 cubic yards) of sand and 84 cubic feet (3.1 cubic yards) of stone.

For C size—33 sacks of cement, 66 cubic feet (2.5 cubic yards) of sand and 132 cubic feet (5.0 cubic yards) of stone.

For D size—42 sacks of cement, 84 cubic feet (3.1 cubic yards) of sand and 168 cubic feet (6.2 cubic yards) of stone.

NOTE:—27 cubic feet = 1 cubic yard, and 1 sack cement = 1 cubic foot, and 4 sacks = 1 barrel.

FILTERS FOR CISTERNS

The very least attention a soft water cistern should receive is a thorough cleaning out twice a year, but a filtering system would improve the quality of the water very much, and the ideal method is one that filters the water before it enters the cistern. As this Department receives many enquiries about cistern filters, some suggestions are given herewith in the hope that interested parties may find something that will apply to their particular situation.

(a) A switch on the downspout for diverting the first washings of the roof upon the ground for each rainfall is helpful if it be given regular attention, but it is not very practical as a rule.

(b) Thorough cleaning of the cistern twice a year is very desirable, and ought to be practicable if a drain be provided as shown in Fig. 8.

(c) The roof water may be emptied into a tank having a capacity of several barrels and an overflow pipe, and located on a higher level than the cistern. From it the water drains into a sand and charcoal filter similar to that illustrated in Fig. 7, through a perforated pipe laid on top of the sand. After filtration the water is carried by a pipe (1") into the cistern. In a one-inch pipe between the receiving tank and the filter a valve is necessary for controlling the flow to the filter, and the flow should be limited to two or three gallons per square foot of filter surface per 24 hours. For winter use the receiving tank and filter should be protected against frost.

(d) The sand, gravel and charcoal filter shown in Fig. 7 may be found very useful for filtering soft water when it has to be used for kitchen uses, but any water used for drinking should be sterilized by boiling, or by adding a standard chlorine solution after filtration.

(e) A porous or soft brick wall in the cistern, dividing the latter into two unequal chambers, may be useful. The water enters the larger chamber and the water is pumped out of the small one, or two porous walls built across the cistern near one end, and about 15 inches apart and the narrow chamber filled with a sand and charcoal filter is another method highly recommended by some.

NOTE:—It must be remembered, however, that all filters become foul and choked in time and the materials must be renewed, and that certain methods of filtering may be more practicable in some cases than in others.

(f) The reader's attention is called to the system illustrated in Fig. 8 for keeping larger things like twigs, leaves, dead birds, etc., from entering the cistern, and also the arrangement of intake and outlet pipes that serves to wash sediment out of the cistern during very heavy rainfalls.

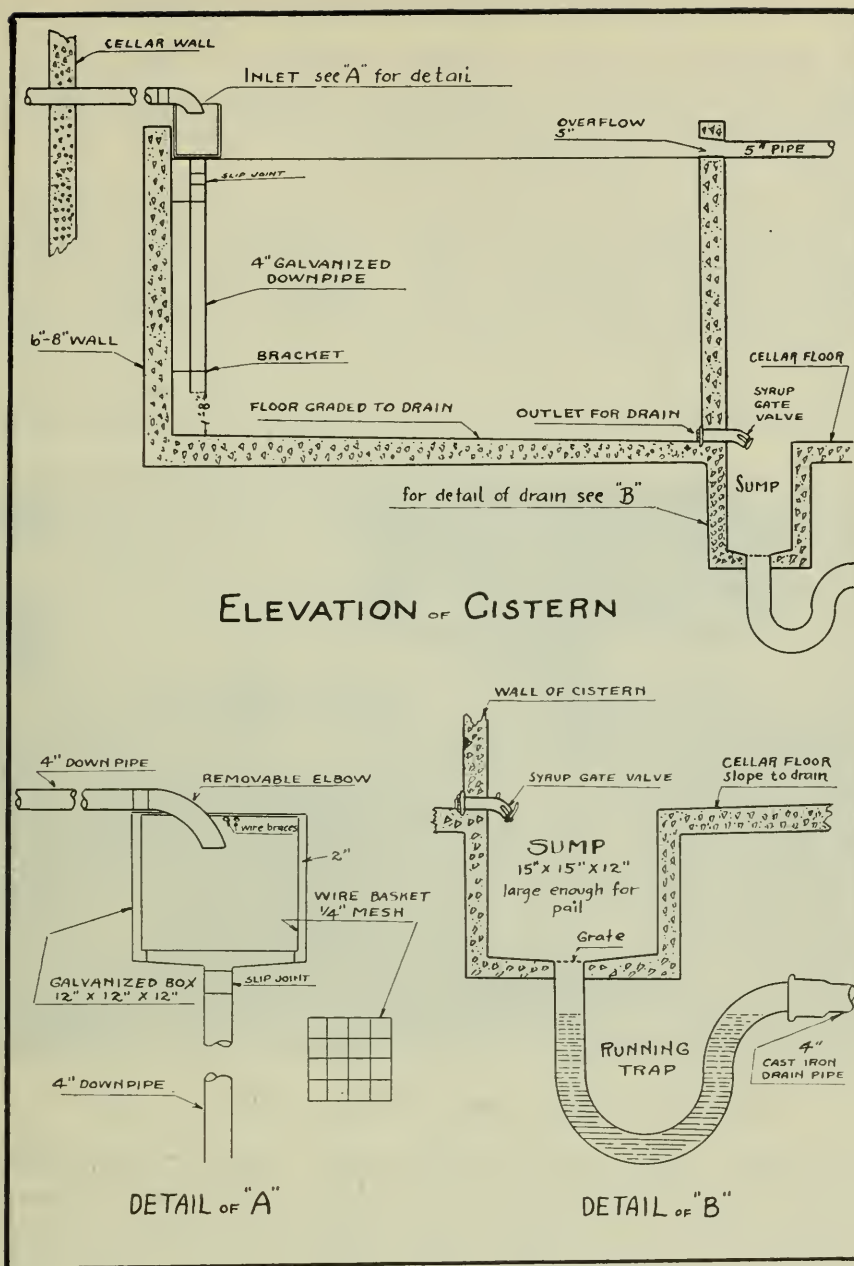


Fig. 8.—Plan of Cistern for basement, and details of a method for catching the large particles of dirt from the roof, and convenience for cleaning the cistern.

LOCATIONS FOR CISTERNS

Small and medium-sized cisterns are usually located in the basement of the house if there is plenty of room. It is advisable to cover these cisterns fairly tight to arrest evaporation and preserve the ceiling. They may be built below the surface outside and probably this is the best place for the larger ones. The same remarks may be made concerning cisterns at the barn.

Old abandoned shallow wells may be converted into cisterns at a reasonable outlay of labor and cost in some instances.

In some cases open reservoirs may be made by plough and scraper where soil is tight, heavy clay with very little seepage, and the same pumped full in the spring season from a near-by creek. A single impeller centrifugal pump run by a tractor engine may be used satisfactorily in such cases.

THE PROBLEM OF QUICKSAND IN WELLS

Beds of quicksand usually contain plenty of water of good quality. In many cases, however, it is difficult, sometimes impossible, to get the water because the quicksand chokes the pipe line and ruins the pump. The trouble may occur in all types of wells.

In general, the treatment in case of dug or bored wells consists of putting a sand filter (Fig. 9) or a flush drive-point (Fig. 5) or something similar to these inside a casing of sheet metal forced down into the quicksand, and after the quicksand is removed from the inside a few inches of fine gravel is thrown into the casing and well packed down, then the filter and pipe line are centred on top of the gravel and the intervening space between the casing and filter packed with similar material higher than the

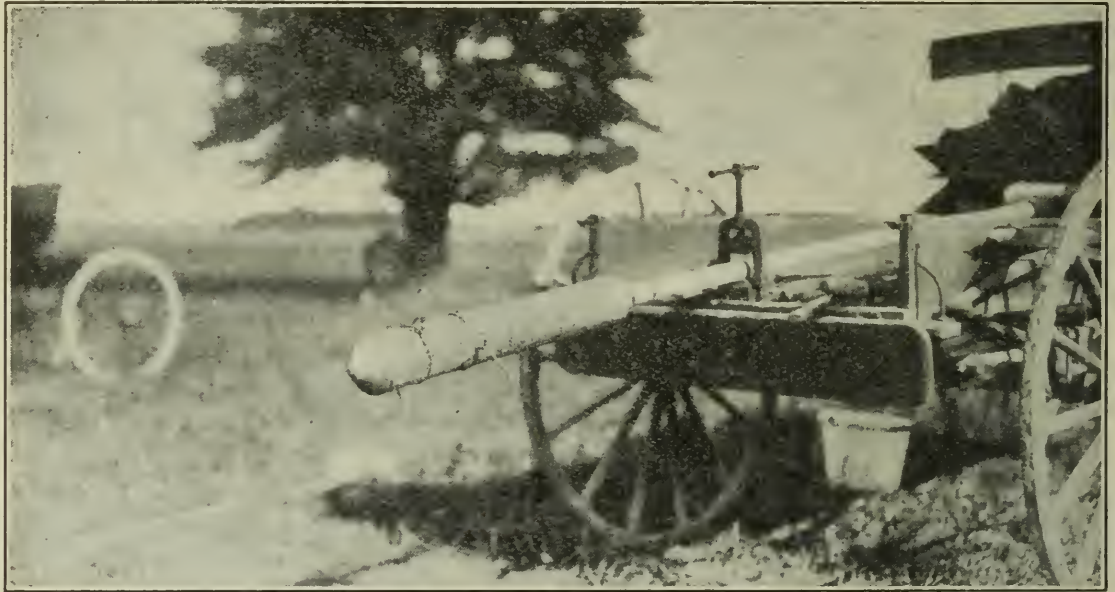


Fig. 9.—Sand filter, to be placed in open drive pipe.

filter. Afterwards the casing is withdrawn. Once the quicksand becomes settled and firm there is no further trouble as a rule. These filters vary in diameter from $1\frac{1}{2}$ to 4 inches. They may be purchased on the market or they may be home-made from a piece of water pipe $2\frac{1}{2}$ feet long, capped on one end, and perforated with several vertical rows of small holes $\frac{3}{8}$ inches in diameter, and a layer or two of fine mesh screen (90 to 60 meshes to the square inch) for covering the perforated pipe, or fine wire may be wrapped as closely as possible over the perforated region of the pipe.

In case of quicksand in drilled wells, the drive-point with flush construction, as shown in Fig. 9, is used as illustrated in Fig. 20, the filter being in direct contact with the quicksand.

HOW TO ENSURE A HIGHER GRADE OF WATER FOR THE FARM

1. Location of wells on higher elevations than any sources of contamination such as barnyards, outside privies, cesspools and septic tank disposal beds.

2. Safe distances from such sources of contamination. No definite distances can be stated as immunity depends a good deal on nature of soils and rocks, also the amount and direction of the grade or slope of the surface.

3. Surface drainage should be definitely away from the top or platform of the well in every case.

4. The platform should be water-tight, and the surface made crowning, and the top should extend slightly beyond the wall of the well.

5. The cribbing of dug wells should be made water-tight by use of stone or brick well cemented or by use of concrete tile for a distance of 10 or 12 feet below the surface. This construction is very effective in preventing small animals, insects, etc., from getting into wells and polluting the water, as well as excluding seepage from the surface.

6. In the case of drilled wells, the platform should be water-tight and the well casing should be forced into the rock, if present, some distance, and the joint at the rock surface packed well.

7. Springs should be protected against the live stock and the top and cribbing made similar to dug wells. The overflow should be taken care of by a surface or underground drain for some distance from the spring.

NOTE:—Illustrations of good well protection are submitted in Figs. 2, 3 and 4.

WATER SYSTEMS FOR THE FARM

On the majority of farms, water is still pumped by hand from wells and cisterns, a system that involves a good deal of hard work and the expenditure of much valuable time. Some, of course, have installed open water tanks in their barns and houses and kept them supplied with water by pumps operated by hand, in some cases, but usually by windmills, hydraulic rams, gas engines, or electric motors in rare instances. By this system they have enjoyed the great convenience of water "on tap" in house or barn or both in a few cases, but on the whole our farmers have progressed very slowly in the matter of installing running water systems, particularly in their homes. However, a change for the better is rapidly coming about, and it is due to the introduction of "Hydro" on their farms. "Hydro" makes possible the use of electric pressure systems which exceed all former systems in efficiency, adaptability, service, cost of operation, etc., in a large degree. For these reasons this system is becoming very popular and quite common today, wherever "Hydro" is used, and will be without doubt the farmers' water system in the future.

THE ELECTRIC PRESSURE WATER SYSTEM

1. **GOOD FEATURES:** Automatic operation, quiet running, and for this reason it can be installed without objection in the basement of the house; water supply is always fresh and cold, as water in tank is changing frequently; cost is reasonable; it is easy to service when necessary; upkeep and operating costs are very low; it occupies very little space; it requires very little attention and is almost fool-proof; it provides a good flow of water at good pressure and is thereby well adapted to many uses about the farm home; it is simple to install, and is just as suitable for deep wells as for shallow ones and cisterns; it is safe and does not interfere with the radio. There are many good makes on the market from which to make a satisfactory selection.

2. SOME HINTS ON MAKING A SELECTION

Type: If the source of water supply be never more than 20 feet below the surface, a shallow well type or unit is the proper one to purchase, and it can be installed in the basement of the house or barn or any place inside

the buildings which is free from frost. Otherwise a deep well unit must be selected and at about twice the cost.

Capacity: The capacity of the pumps and size of the pressure tanks vary with the quantity of water used; if system be used only for house service the pump should have a capacity of about 200 Imperial gallons per hour and the tank about 40 gallons; for house and a very few head of stock together 300-gallon pump (usually a twin cylinder one) and a 60-gallon tank and proportionately larger pumps and tanks for larger families and more stock in the stables. Lawn and garden service and fire protection are other determining factors to be reckoned with in deciding on the capacity of the system.

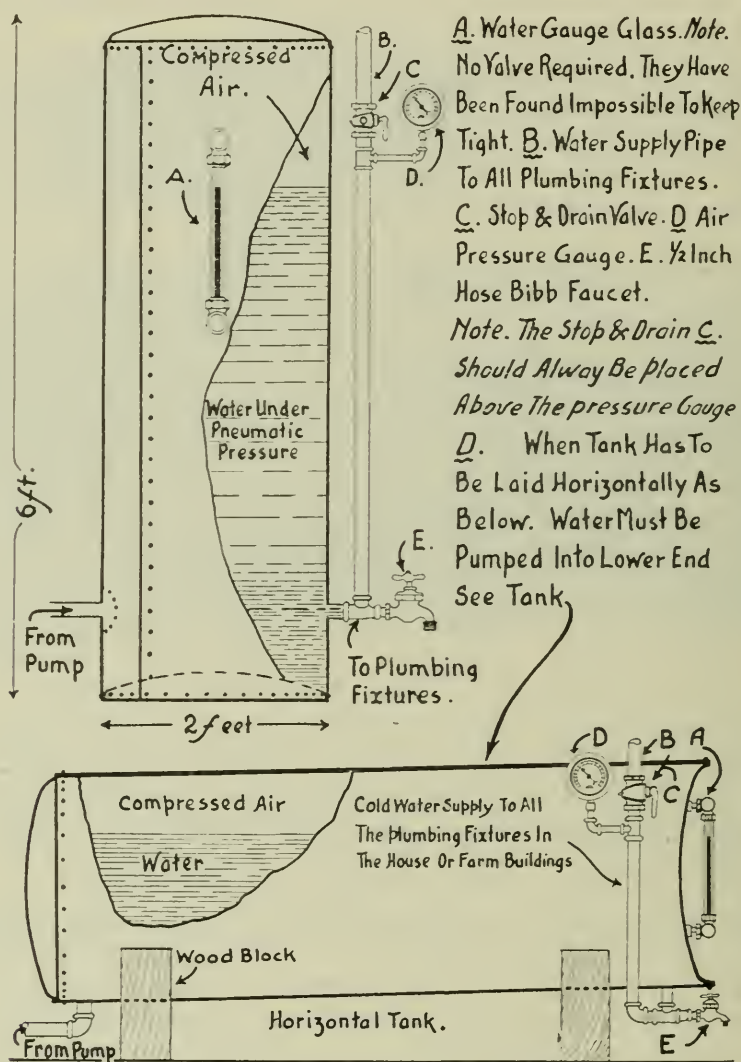


Fig. 10.—The water pumped into the tank compresses the entrapped air which forcibly expels the water when a faucet is opened.

Servicing: Ease and convenience in servicing the system, such as accessibility of plunger, valves, packing glands, etc., and ease in tightening the belt, changing oil in crank case, etc., are worth-while considerations. Deal with firm or agency of high repute, long and successful experience in this type of equipment, and one that can guarantee quick service in case of a serious breakdown or sudden call for repairs.

Features: The pump should possess good design, strength and rigidity in construction, reasonable compactness, and have a neat appearance.

3. INSTALLATION

Of shallow well units: Put unit in a frost-proof, dry, clean and bright place, preferably the house basement. Mount it on a solid, level base a foot or so above the floor level and bolt it down firmly. Follow "Hydro" rules regarding the wiring, switch, fuses, etc (see Fig. 12). Use $\frac{3}{4}$ -inch pipe, best galvanized grade, for suction line. It should be laid on a uniform grade of $\frac{1}{4}$ inch or more per foot run towards the well and in a frost-proof trench. On the end in the water a combination check valve (spring control type) and strainer should be attached and the other end should be connected to the pump by a union. The threads on the sections of pipe should be thoroughly made, and lead paste used on the joints, which should be screwed up firmly but not forced. Do not fill in trench until the pump has been run to make sure that there are no leaks in the line. In the discharge line ($\frac{1}{2}$ inch diameter) from the tank put a hose cock at the base, and a stop-and-waste cock and pressure gauge at a convenient height from the floor (see Fig. 12) for cutting off the water and draining the pipes above

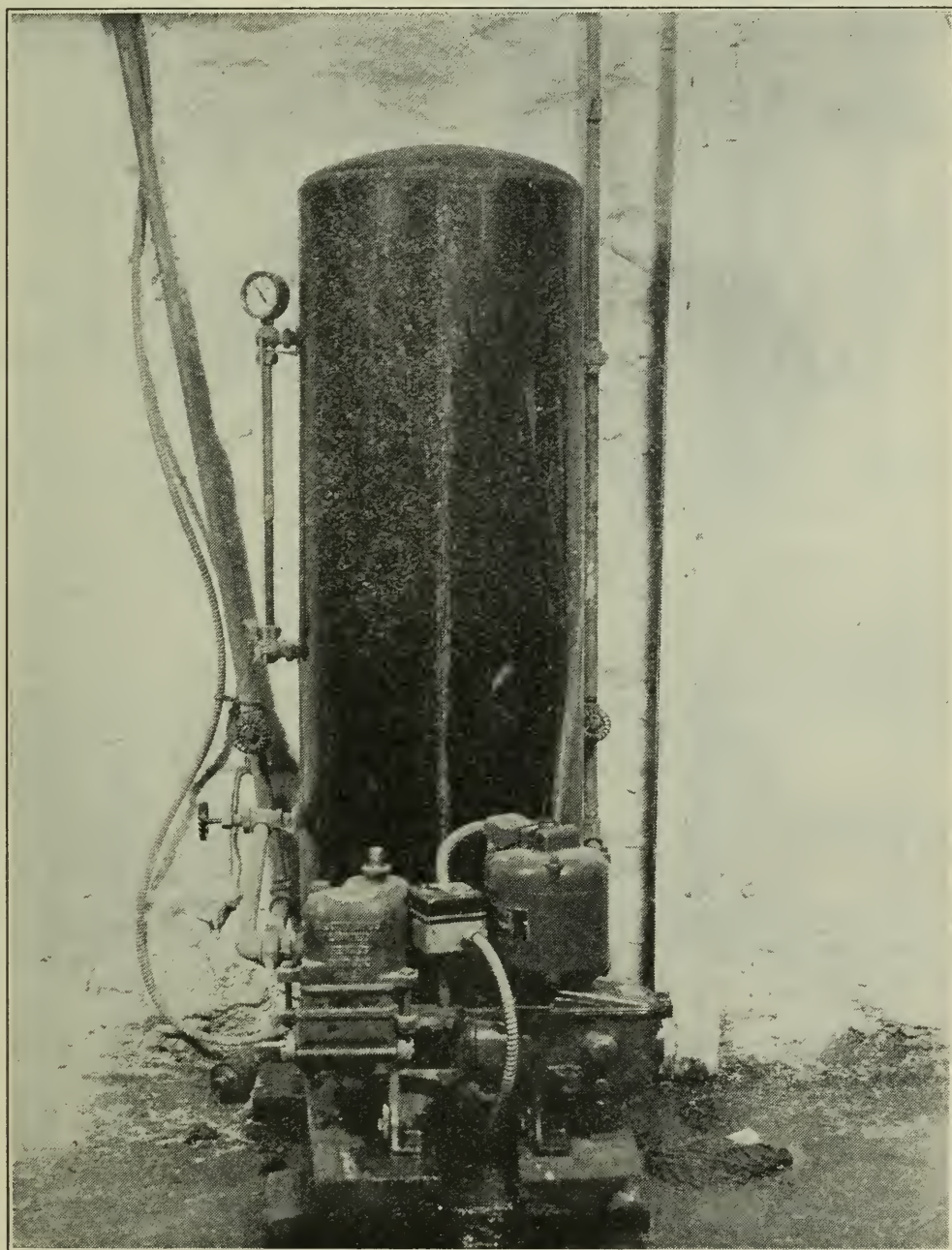


Fig. 11.—Direct-drive pump for Compression Water System.

tank when necessary. Fill crank case with a light oil to level of filler, oil motor bearings. Prime pump before starting it, and if it does not bring the water in a reasonable length of time examine the valves in case they may be stuck or dirty. Make sure that plug in top of tank is tight, and the cap on end of air valve is tightly closed before starting the pump.

NOTE:—Follow carefully the directions and information supplied with the outfit in pamphlet form, and hang it up close to the unit for reference.

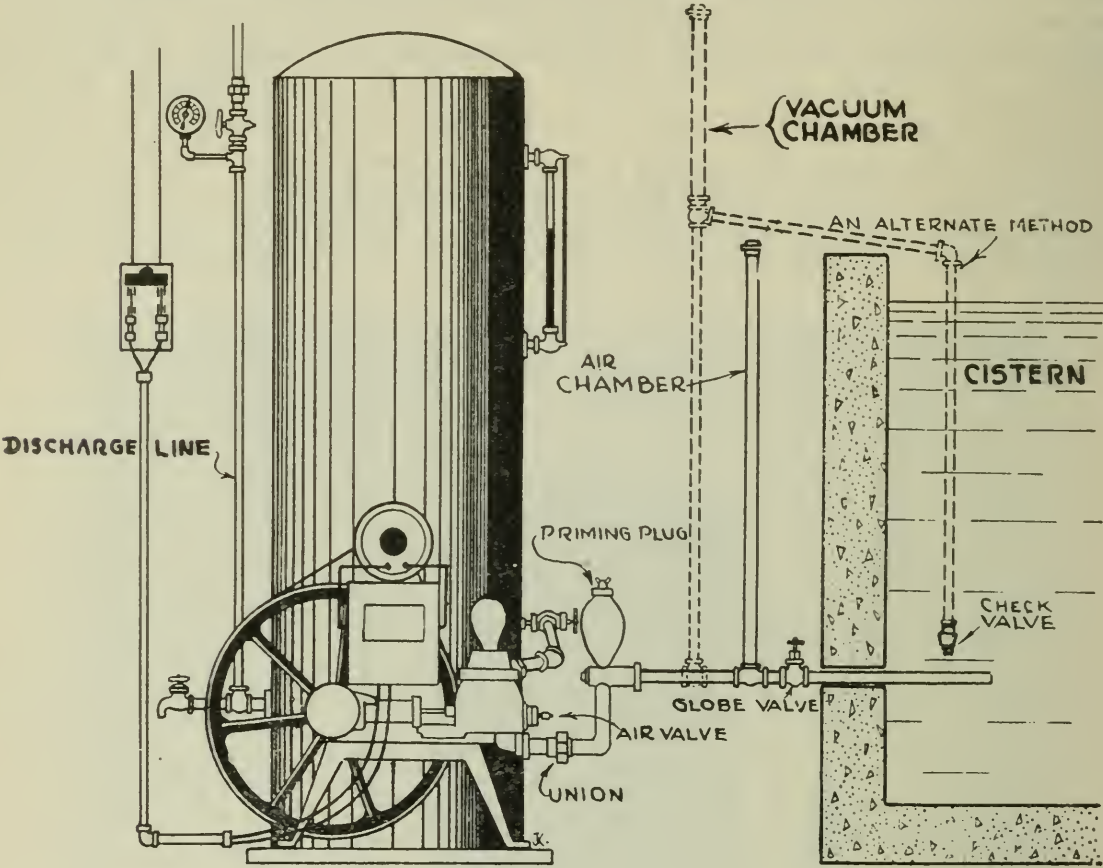


Fig. 12.—Details of two layouts of suction line of water system connected to cistern.

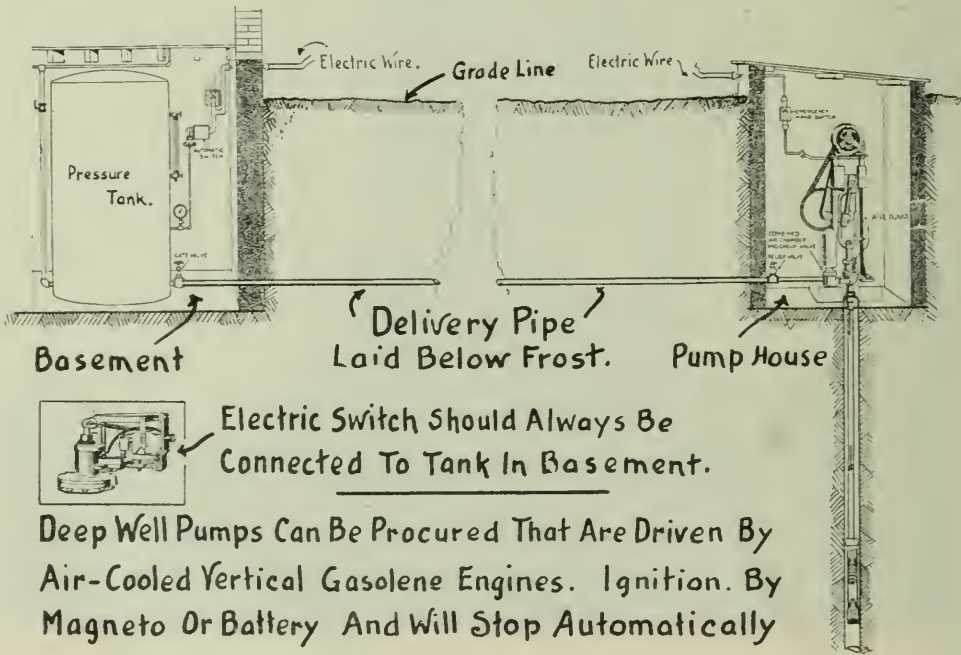


Fig. 13.—Deep well pneumatic water system with tank in house.

4. CARE AND ATTENTION. This is very important!

(1) *Oiling*: Change oil in crankcase twice a year and see to it that motor oil cups always show oil.

(2) *Valves and plunger leathers*: These parts are subject to more or less wear, corrosion and breakage, and they should be periodically examined and repaired and cleaned if necessary.

(3) *Piston rod packing*: The slightest evidence of leakage here should call attention to need for adjustment. New packing may be necessary from time to time. If leak be serious, air will get into cylinder and interfere with the suction.

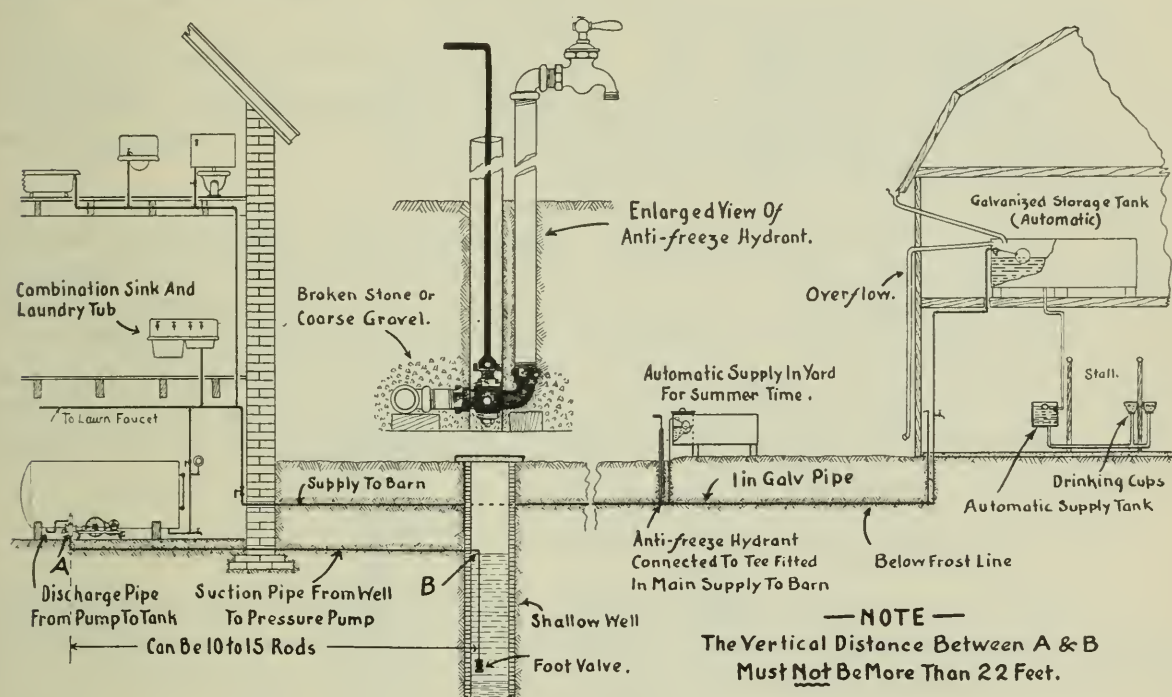


Fig. 14.—Barn supplied with water from house pressure tank and from barn roof.

(4) *Relief valve*: This valve is located between the pump and the tank, sometimes directly on the air chamber. It is a protection against injury or possible "blow out" of tank should excessive pressure develop owing to automatic switch failing to open at the proper cut-out pressure. It should be checked occasionally to make sure valve is not stuck by rust or corrosion.

(5) *Motor*: It should not be kept in a very damp or dusty place and, as stated, it should never run dry for lack of oil.

(6) *Belt adjustment*: If pump be belt-driven, some attention is needed to regulate the proper tension. On recent models this adjustment is made easy by set screws or slots in base of motor. These directions, of course, do not apply to the direct-drive unit.

(7) *Air inlet valve*: This is a rubber tire valve connected to the head or one side of the cylinder for the purpose of supplying air to the tank to offset any leakage in tank wall or escape in the water. Most units now have a gadget for operating this valve automatically, but if not automatic this valve needs some attention to keep air volume in tank at the right proportion to water. Loosening the cap will permit air to enter while pump is running, but normally it is closed tight. If pressure is low, open valve for a while, but make sure of closing it when air supply is adjusted.

(8) *Strainer on suction line*: Some units use this. Its function is to arrest dirt coming up suction line and protect the valves. It should be taken out occasionally and cleaned in order to keep the line always clear.

(9) Follow directions in pamphlet referred to, and take a keen interest in the unit at all times; if so, system should give long and satisfactory service.

5. **THE DEEP WELL OUTFIT AND ITS INSTALLATION.** In this case the deep well head or pump jack and motor or gas engine, as the case may be, are placed in a shelter built over the well platform or, better still, put in a pit sunk over the well. The cylinder is put below the surface of the water (see Figs. 13 and 17). In farm installations of this type the pressure tank is usually located inside the buildings, but it may be put inside the pit or buried horizontally below the surface near the pit with one end protruding into the pit (Fig. 16). Note also Fig. 17, where windmill is used as the source of power for operating the pressure system. However, the windmill is commonly used for open tank systems and is better adapted to this method than the other.

6. **CASE OF REMOTE CONTROL.** Sometimes the suction lift is well within the regulation height, *i.e.*, 20 - 22 feet, but the source is far removed from the farm buildings. If pump be located at the buildings it means that a very long suction is necessary and this is not practicable as the friction in the long line may increase the suction lift beyond 22 feet and besides it is difficult to avoid leaks in a long line. This case is handled by the methods shown in Figs. 15 and 16, the latter layout being the better one as a rule.

NOTE:—100' extra suction line increases the suction lift 1 foot for small installations.

7. **ONE-PUMP TWO-TANK SYSTEM.** With shallow well and cistern supplies available both kinds of water may be "on faucet" throughout the house by means of one pump and two pressure tanks but details are not given here as we favor two separate pressure units for this dual service. However, blue-prints are available and free on application to anyone wishing to install the one-pump two-tank system.

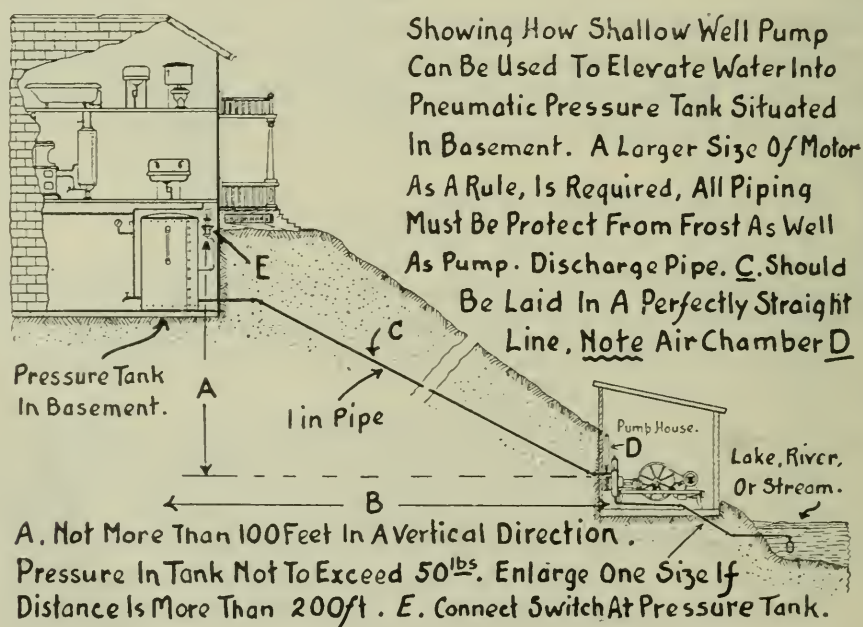


Fig. 15.—Remote control layout; pump close to source, and pressure tank in basement.

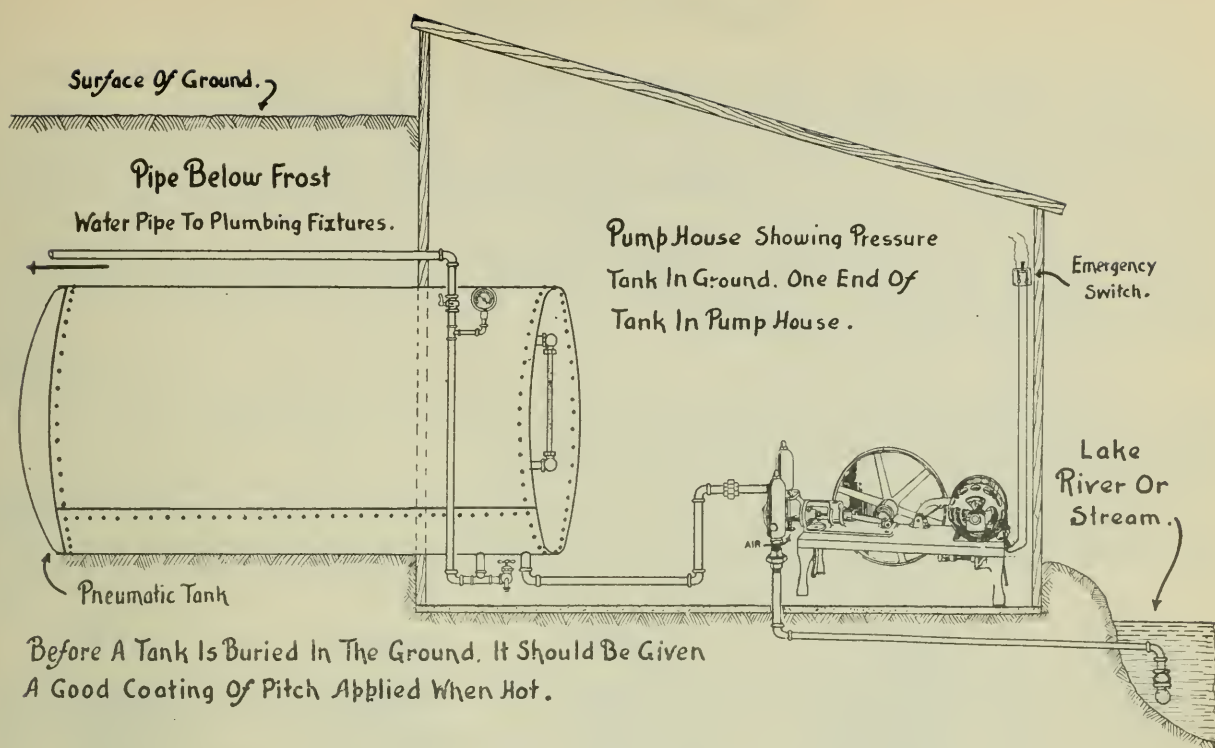


Fig. 16.—Remote control layout; both pump and tank in pump house.

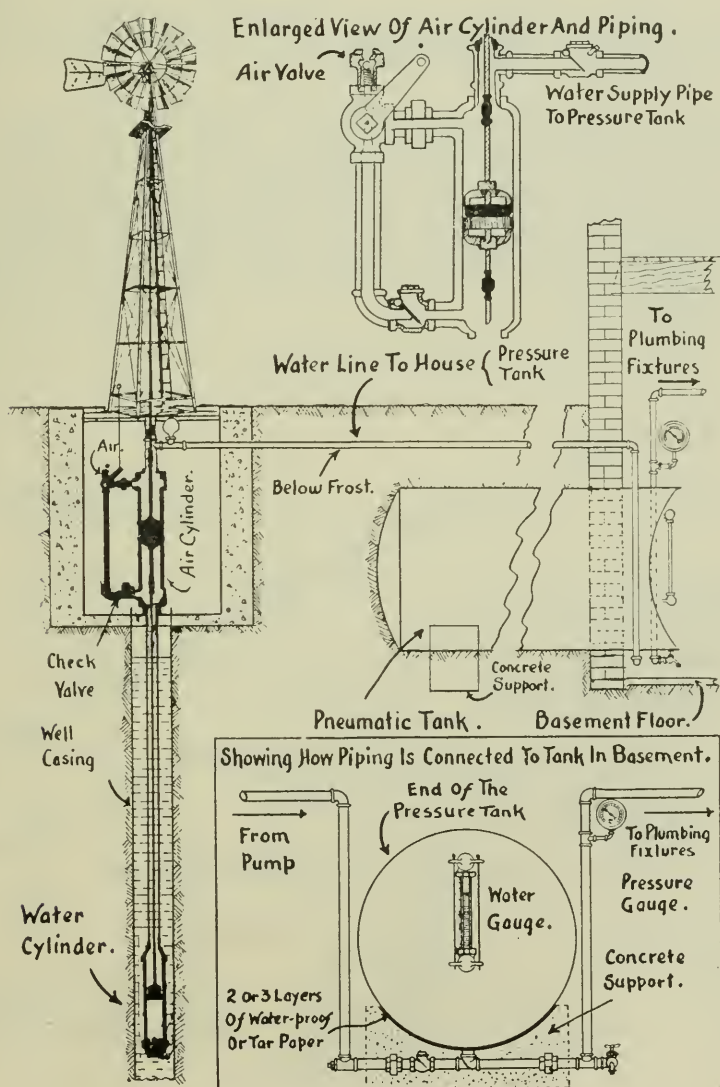


Fig. 17.—Wind engine driven pneumatic water system.

GRAVITY SYSTEM

There is the rather rare instance where a good supply of water may be made available at the farmstead by piping to a good spring on an elevation high enough to force water into the house and stables. The details are shown in Fig. 18. If the elevation was not enough to force water to the bathroom on the second floor, the spring water could be delivered to a cistern in the basement or outside, the flow being controlled by a float valve on the cistern or tank, and a pressure system used to force the water to all parts of the house and stables.

The following table will be useful in determining the proper size of pipe to install between the spring and the buildings, assuming a flow of 5 gallons per minute, which is usually enough.

Table for estimating the size of pipe required for any head (10 - 25 feet) and distance up to 9,000 feet for 5 gallons per minute flow:

Size of Pipe	Head 10'	Head 15'	Head 20'	Head 25'
$\frac{3}{4}$ "	150' pipe	200' pipe	275' pipe	350' pipe
1"	450' pipe	650' pipe	900' pipe	1100' pipe
$1\frac{1}{4}$ "	1600' pipe	2500' pipe	3300' pipe	4200' pipe
$1\frac{1}{2}$ "	3500' pipe	5600' pipe	7000' pipe	9000' pipe

NOTE:—Head in feet means the difference in elevation between the spring's level and that at the discharge or outlet level.

How to use the Table: Pick out the "Head" column nearest to the given Head, follow it downwards to length of pipe nearest the given pipe line, then move straight across to the extreme left column and the number there is the size of pipe required. As an example, if Head be 15 feet and length of pipe line be 2,500 feet the size should be $1\frac{1}{4}$ inches for a flow of 5 gallons per minute.

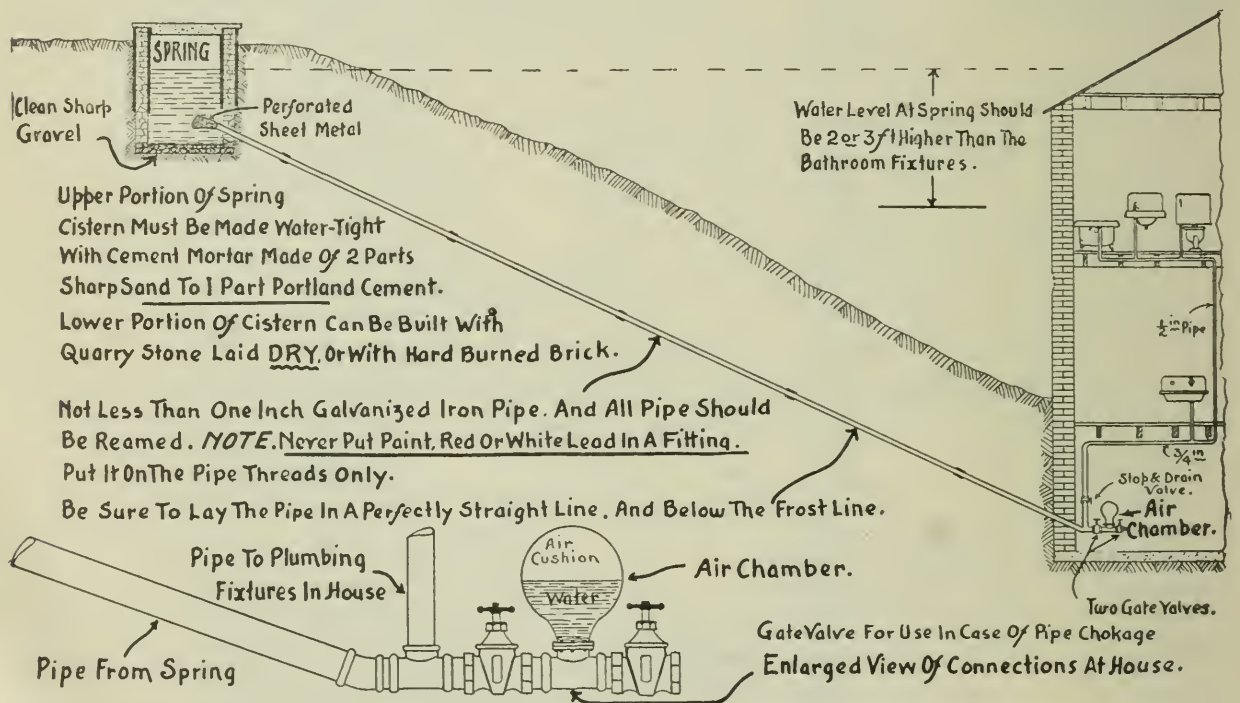


Fig. 18.—Spring Water Piped to the House.

PUMP CYLINDERS

TYPES OF PUMP CYLINDERS AND THEIR SPECIAL USE

The most common types of pump cylinders are illustrated in Figs. 19 and 20. They may be classified as follows:

(1) *Iron cylinders with outside caps*, as shown in Fig. 19 A. They are the cheapest cylinders and are used on dug or shallow wells where there is a total head of about 25 feet. Only one leather is used on the plunger.

(2) Same as above except that they are lined with brass. They cost a little more, but give better and longer service. They may be used on either shallow wells, or deep wells too, where well is large enough to take cylinder with outside caps. See Fig. 19 B. Fig. 19 C is same as B except that the plunger and check valve are different in design.

(3) *Solid brass cylinders* (Fig. 19 D). These are designed for drilled wells. Inside caps are used. Number of leathers on plunger vary according to depth of well. Two leathers for 75-foot well and 3 and 4 leathers for deeper wells and where pump is working against heavy pressures.

(4) *Working barrels* (Fig. 20 A, B, and C). This type has no caps but is threaded on each end and is coupled in the drop pipe at a point below the water level. They are made of either brass or iron shell lined with brass. The internal diameter on the lower end is reduced slightly in size to accommodate the check valve, as shown in Fig. 20 A and C. The check valve may be removed by lowering the plunger and screwing it into the check valve and pulling both up the drop pipe to the surface without the laborious task of taking the cylinder and pipe line out of the well. Working barrels are recommended for wells 80 feet or more in depth, and a wooden pump rod is better than an iron one with this type of cylinder. In Figs. 20 A and G is shown how this cylinder may be used with a drive-point in case of quicksand. *Spring controlled valves are commonly used in this type of cylinder.*

SIZE OF CYLINDERS AND SUCTION PIPE

The size of cylinders is rated by the diameter in inches and the length of the stroke. The following table may be found useful in deciding upon the proper size to use in any well. The different types of plungers and styles of valves are clearly shown in Figs. 19 and 20.

SIZE OF CYLINDERS AND SUCTION PIPE FOR WELLS OF VARIOUS DEPTHS

Depth of Wells	Size of Cylinders	Size of Suction Pipe
20 feet or less	6 inches	3 inches
25 " "	5 "	2½ "
35 " "	4 "	2 "
50 " "	3½ "	1½ "
75 " "	3 "	1½ "
150 " "	2½ "	1¼ "
200 " "	2 "	1¼ "

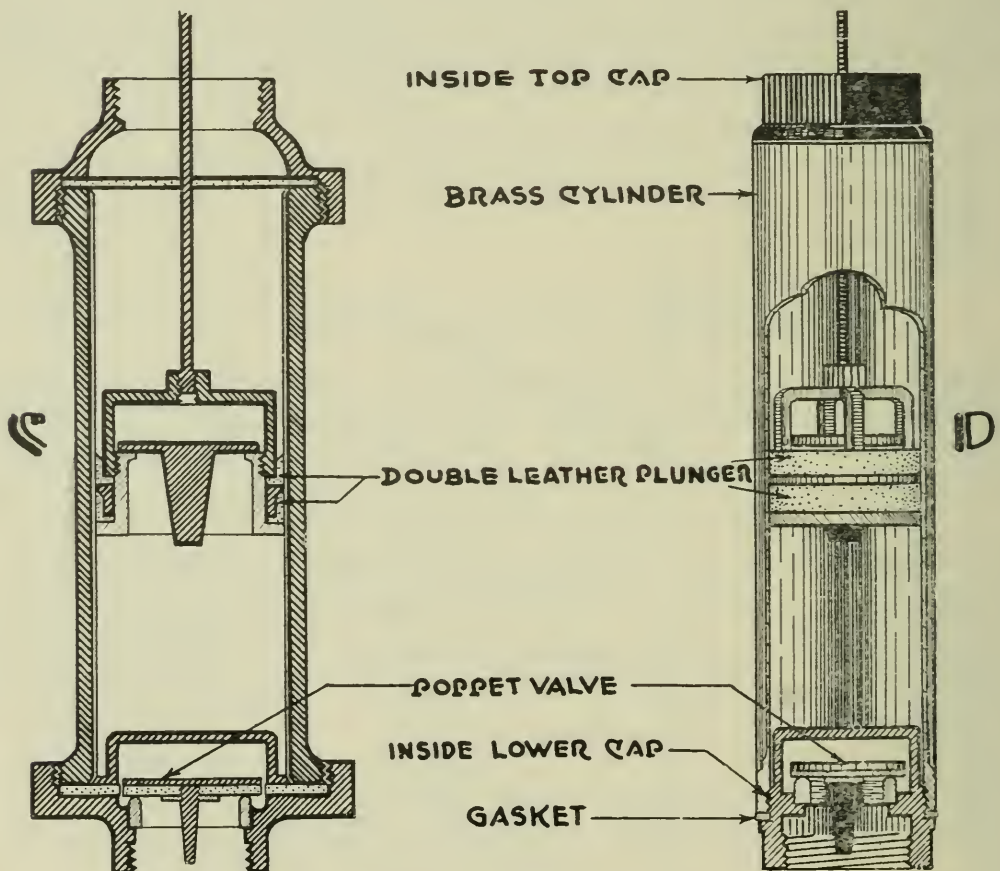
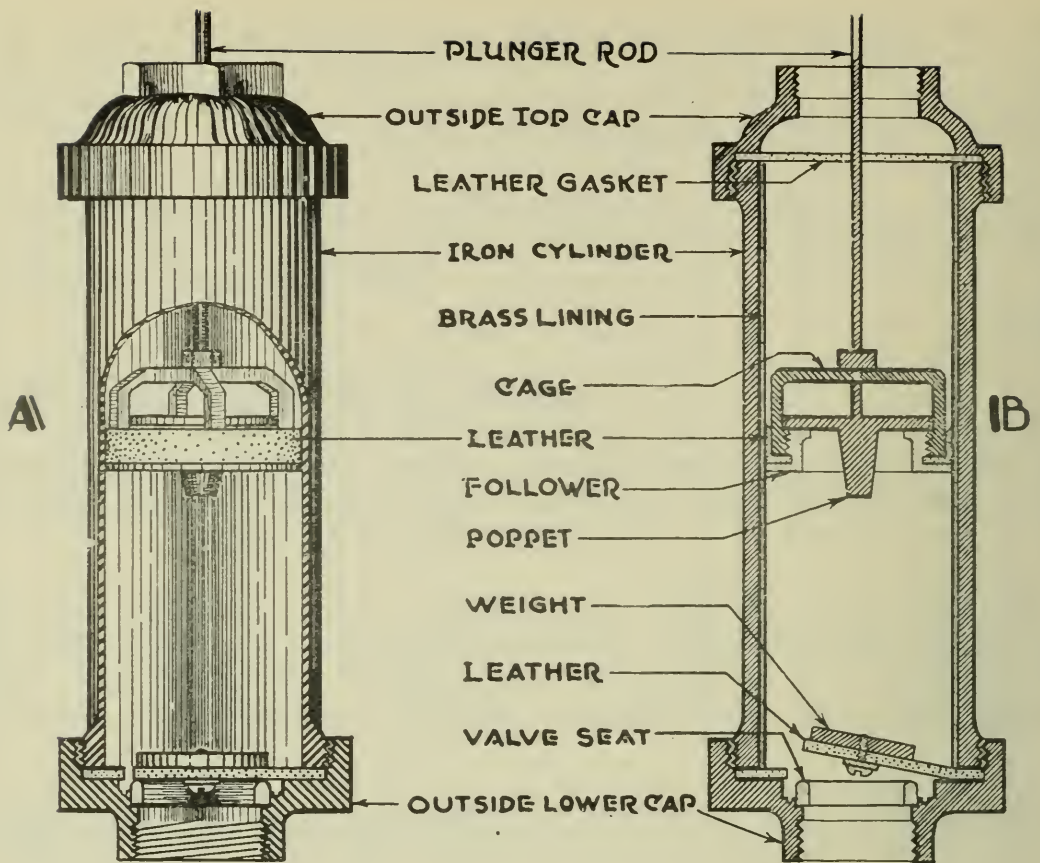


Fig. 19.—Shallow and Deep Well Cylinders.

CAPACITY OF CYLINDERS

The following table gives the capacities for cylinders two to six inches in diameter and on a basis of forty strokes per minute in case of 6-inch, 8-inch and 10-inch strokes.

Diameter of Cylinder in inches	Gallons raised per hour at the rate of forty strokes per minute to level of pump.		
	6-inch stroke	8-inch stroke	10-inch stroke
2 inches	163	220	275
3 "	365	487	608
4 "	625	869	1,086
5 "	1,020	1,360	1,700
6 "	1,460	1,947	2,433

POWER REQUIRED FOR PUMPING WATER

Under ordinary conditions very little power is required, as indicated for a few instances in the following table:

Size of Cylinder in inches	Gals. pumped per hour on a 10-inch stroke	H.P. for 100 ft. elevation	H.P. for 200 ft. elevation
2-inch	200	$\frac{1}{8}$	$\frac{1}{4}$
3-inch	735	$\frac{1}{4}$	$\frac{1}{2}$
4-inch	1,300	$\frac{3}{5}$	1
5-inch	2,000	$\frac{4}{5}$	$1\frac{1}{2}$
6-inch	2,935	$1\frac{1}{4}$	2

NOTE:—The H.P. values given in the table are theoretical, to get the actual size of gasoline engine required multiply these values by two, for electric motor multiply by one and a half.

How to calculate actual H.P. to run pumps:

Actual H.P.= $\frac{W \times H}{33000 \times E}$ where W=weight of water in pounds

33000 x E

lifted per min. H=total head, and E=
efficiency which is usually about 80%.

Total head=elevation lift+friction head in pipe line+
pressure at end of line.

PUMP TROUBLES AND HOW TO REMEDY THEM

Almost every pump trouble has a very definite symptom. A knowledge of the *principle of pumping, pump parts and how they work* will help one to detect pump troubles and remedy them.

1. If pump fails to deliver water first see if there is any water in the well or not.

2. If pump loses its prime, the suction valve (see lower valve, Fig. 19) is defective or something has lodged under it, preventing its closing. Remedy is to repair or clean it.

3. If pump is delivering a good deal of air and very little water,



Fig. 20.—Deep well cylinders, plungers and checks.

there is an air leak in the suction line or cylinder, probably a loose joint or hole in pipe, or well is running dry. Plug the leaks.

4. If the handle works up and down without apparent resistance, and delivers little water or none at all, it indicates that the plunger leather is worn and not creating a vacuum in cylinder, or else suction valve is not working properly. Probably suction pipe is too low or well is filling up. Remedy is to take pump apart and make necessary repairs.

5. If pump works hard or handle jerks up when pushed down, it is evident that something is preventing the water rising in the suction pipe to cylinder. This may be due to too small a suction pipe or end of pipe is choked by something in bottom of well, or cylinder is too far above the water.

6. If the water splashes out at the top of the pump it is a sign that the cylinder is too large for the head. If pump is taking in air below the cylinder it will also have a tendency to do this.

7. Noise in pumps may be due to loose joints, dirty valves, absence of air chamber particularly in power pumps, long pump rods striking sides

of pipe, loose bearings in connecting rods, driving pulleys out of alignment and lack of oil on all wearing surfaces.

8. Pumps sometimes may be hard to work because the pipe above the cylinder is too small for the cylinder; it should be at least one-half the diameter of the cylinder.

NOTE:—Periodic checking of pump parts and their operation will avoid much trouble and ensure much better service with less labor and lower cost.

WATER TANKS

(a) COMPRESSION TANKS

COMMON SIZES OF COMPRESSION TANKS FOR FARM SERVICE

Diameter in inches	Length in feet	Full Capacity Imperial Gals.	Working Capacity $\frac{2}{3}$ Full
13	1½	11	7
12	2½	15	10
16	4	42	28
18	4	53	35
18	5	66	44
24	4	100	66
24	5	120	90
30	6	220	146
36	6	315	210

NOTE:—1 Imperial gallon equals 1½ U.S.A. gallons.

(b) OPEN WATER TANKS FOR STABLES

WATER TANKS — SIZES AND CAPACITIES

Style of Tank	Dimensions			Capacity
	Diameter	Height	Length	
Round Steel Tanks.....	4 ft.	4 ft.	.....	297
	4 ft.	5 ft.	.....	372
	5 ft.	5 ft.	.....	587
	5 ft.	6 ft.	.....	695
Round End Steel Tanks.....	2 ft.	2 ft.	4 ft.	78
	2 ft.	2 ft.	6 ft.	122
	2½ ft.	2 ft.	8 ft.	206
	3 ft.	2 ft.	10 ft.	317
Round Wood Tanks	4 ft. (bottom)	.....	4 ft.	285
	4 ft.	.....	5 ft.	360
	5 ft.	.....	5 ft.	570
	5 ft.	.....	6 ft.	675
Square and Rectangular Tanks..	Length	Width	Depth	
	5 ft.	4 ft.	3 ft.	375
	4 ft.	4 ft.	4 ft.	400
	6 ft.	4 ft.	4 ft.	600
	6 ft.	5 ft.	4 ft.	750
	6 ft.	5 ft.	5 ft.	937

NOTES:—1 cubic foot = 6¼ Imperial gallons, or 7½ U.S.A. gallons.

ESTIMATED WATER CONSUMPTION ON THE FARM FOR VARIOUS USES

Water carried	8	gals. per person per day.
Pump at kitchen sink	10	" " " " "
Faucet at kitchen sink	12	" " " " "
Running hot and cold water in kitchen	18	" " " " "
Complete plumbing with water under pressure	30	" " " " "
Bathtub*	8-20	gals. each time used.
Closet*	3-5	" " " " "
Lavatory (wash basin in bathroom)	1-2	" " " " "
Sprinkling lawn	8	gals. per 100 square feet.
Soaking lawn	20	" " " " "
Cow	15	gals. per day.
Horse	10	" " " " "
Hog	2	" " " " "
Sheep	1½	" " " " "

The daily total consumption varies considerably, depending on the size of family, whether plumbing is installed in the house or not, care of faucets and toilet, frequency of baths, and the amount of stock kept.

THE HYDRAULIC RAM

The *Hydraulic Ram* is an apparatus that makes use of the energy of a large quantity of water operating through a few feet fall in order to lift a comparatively small quantity of it to a considerable height. It is self-acting and the first machine dates back to the year 1796.

Its chief use in this country is for pumping water from a spring at some point on the farm to the house or barn for domestic uses. In rare cases large rams are used to supply water from springs or other sources for irrigation, watering stations on railroads and such like instances.

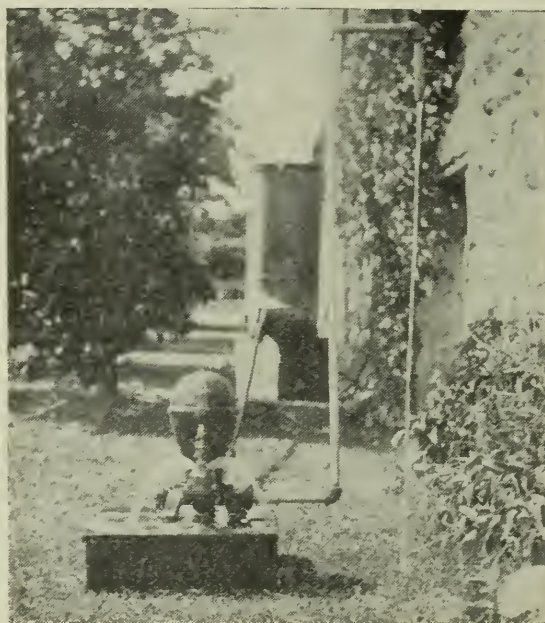


Fig. 21.—Hydraulic ram in action on test at O. A. C., Guelph.

ADVANTAGES

It has many, chief of which are: It doesn't require wind, electric, gas or other source of power for operation, needs very little attention and few

repairs and no oil, the maintenance cost is therefore practically nil, and it will give continuous service for many years. The initial cost, too, is low.

THE CONSTRUCTION OF THE HYDRAULIC RAM

For those who are not familiar with the hydraulic ram, a few words regarding its construction may be appreciated. The particular design described herein is commonly known as the standard hydraulic ram, being the one to which our Department has given special study, both in the laboratory and in actual service on many farms. There are, however, other types which give equally good service.

The design and construction of the ram itself are well shown in Figs. 22 A and B. The main parts are base, dome, waste-valve, spring check at base of dome, inlet and outlet, air supply or snifter valve. See Fig. 22 B for further details.

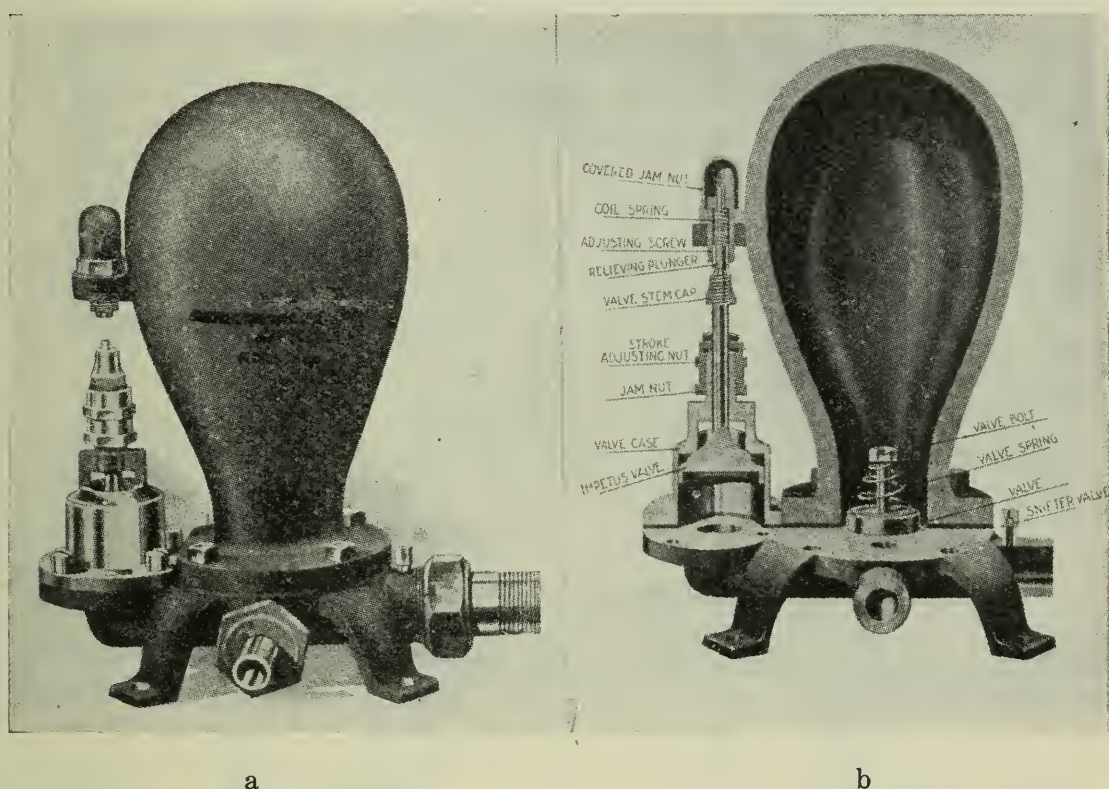


Fig. 22.—(a) The standard hydraulic ram in perspective. (b) Vertical section of same.

HOW THE RAM OPERATES

Referring to Fig. 23, the principle may be understood by the following account: When the water is turned on the drive-pipe and suddenly rushes into the base of the ram, a good deal of it immediately escapes at valve "W" as it is open, but as soon as the water gathers enough velocity this valve closes and causes the velocity energy of the moving column of water to be changed into pressure energy which opens the valve "C" and allows a small quantity of water to enter the dome. When this occurs the waste valve "W" opens again and the cycle of operations as described is renewed. The air pressure in the top of the dome maintains a steady pressure on the water below and forces it up the discharge pipe leading to the storage tank.

Why the air-dome? In this operation just described the cushion of air in the top of the dome transmits the pressure energy in the drive-pipe

to the column of water leaving the dome and forces it in a steady stream to the tank in the buildings, and causes the ram to operate quietly and efficiently.

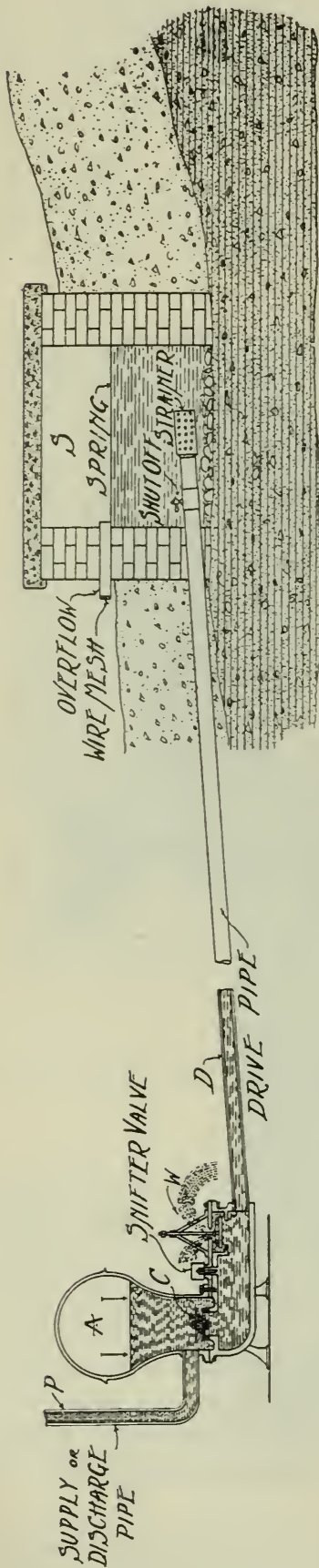


Fig. 23.—Sectional diagram of hydraulic ram installation.

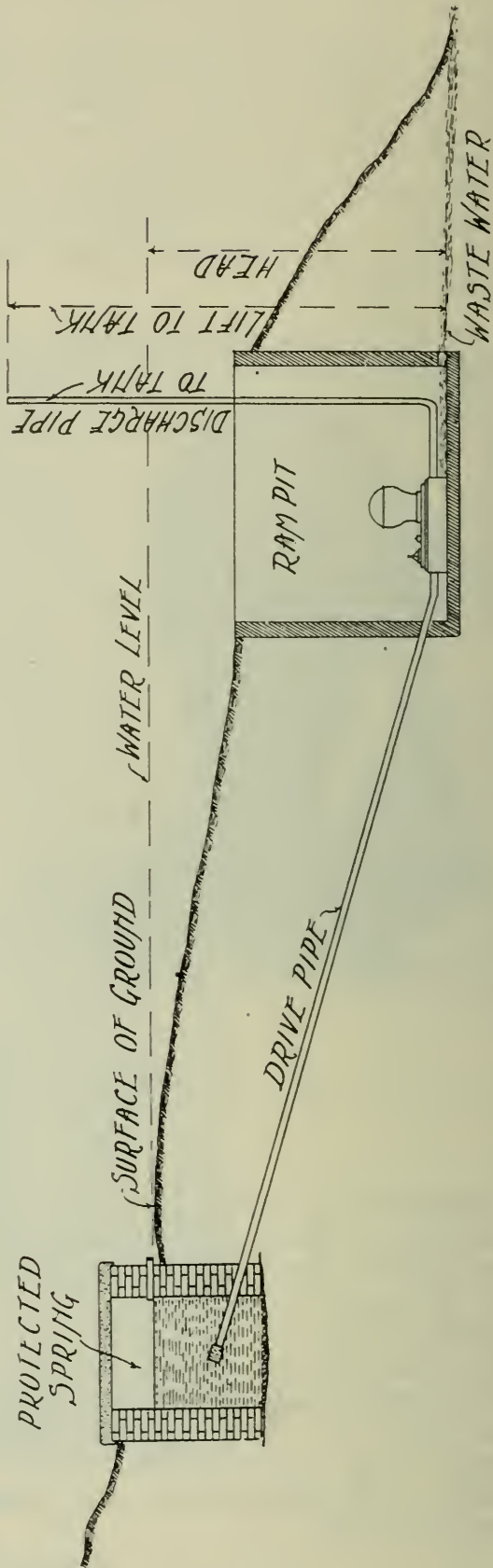


Fig. 24.—The hydraulic ram installation under ordinary conditions, ram close to spring.

WHEN MAY A HYDRAULIC RAM BE USED?

The Hydraulic Ram will usually operate very successfully under these conditions:

(1) *Plentiful and constant supply of water at the spring.* The commonest size of hydraulic ram for farm use is No. 4 and it requires 6 to 10 gallons of water per minute, or what a 1½-inch pipe will carry under a few feet of head. The flow at the spring should be measured in gallons per minute and this can be done easily if there is an overflow pipe.

(2) *A few feet fall or head* (see Fig. 25 for illustration of head and lift). Rams will operate on as low a head as 18 inches but a few feet, usually 5 to 10 is necessary. It depends upon the height the water has to be lifted. *The amount of head needed can be easily figured by the rule that 1 foot head is equivalent to 10 feet lift.* The fall and lift should be accurately determined by a levelling instrument, or a makeshift, using a carpenter's level, may be used when the other is not available.

(3) As the ram is usually placed in a shallow pit, and there is a constant waste of water in the operation, a drain must be carried away from the bottom of the pit to take care of the waste water. If flooded, the ram wouldn't work for very long (see Fig. 25).

(4) When a depth of at least 12 inches of water over the end of the feed pipe in the spring is always present. The feed pipe should enter the spring or source near the bottom, not the top.

(5) When a fairly constant head of water does not exist, sometimes a barrel or tank is placed between the spring and the ram for the purpose of maintaining a constant head on the ram (see Fig. 25). The barrel is not always necessary and is seldom used, the pipe leading directly from spring to ram as in Fig. 25.

DIRECTIONS FOR INSTALLING THE RAM

After it has been definitely determined that the right conditions

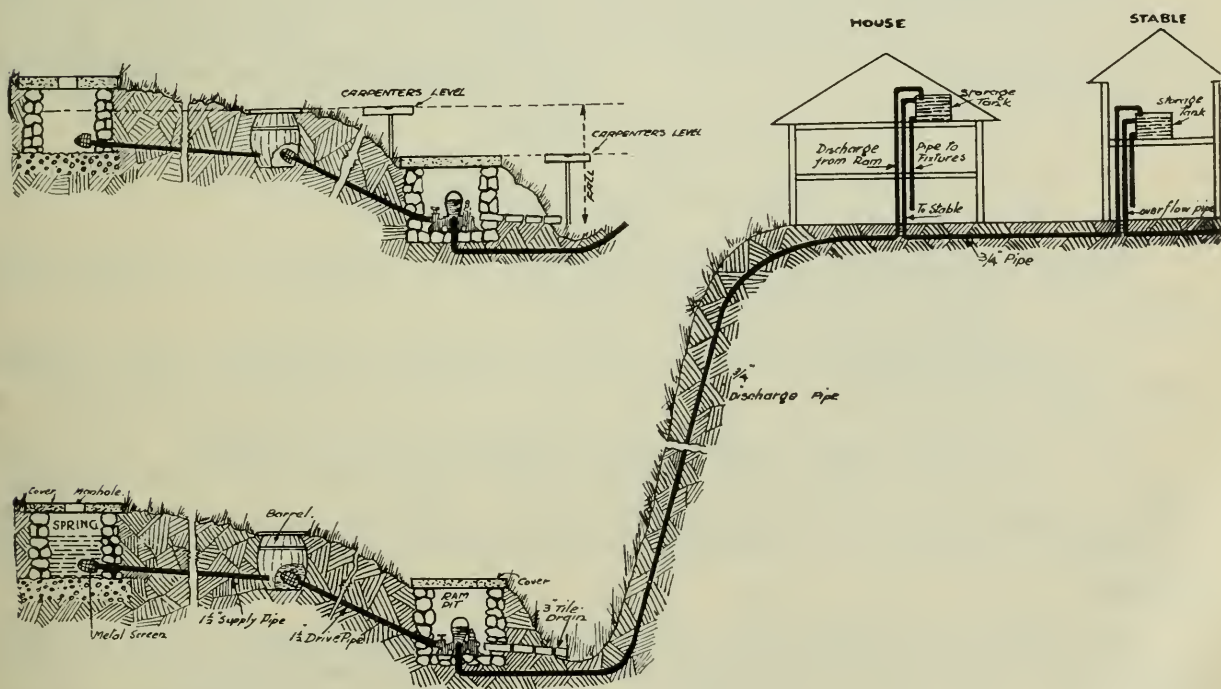


Fig. 25.—A typical hydraulic ram installation.

obtain for using the ram successfully and the material has been purchased and delivered, the next important thing is to put it in properly.

(1) The spring should be cleaned out and properly cribbed, and a tight top and an overflow pipe provided (see Fig. 25).

(2) Selecting the best site for the ram: It must not be placed nearer the spring or source than 5 to 6 times the available head, but it may be put farther away if it be more convenient to do so.

(3) The site selected must provide for good drainage from the bottom of the pit (see Fig. 24).

(4) If ram has to be put 100 feet or more from the spring, an open standpipe should be installed on the feed pipe at a distance of 40 or 50 feet from the ram (see Fig. 26).

(5) Use size of pipe for feed and discharge as specified for the particular sizes of ram. Galvanized pipe is best (see table, page 36).

(6) Put the pipes below the ground at a reasonably safe distance below frost, but this is not always essential as running water doesn't freeze as quickly as standing water.

(7) Avoid absolutely any sharp turns in the feed pipe, not so necessarily for the discharge one.

(8) Install a *gate-valve* (not a globe) on feed pipe just inside the pit for turning on or off the supply to the ram when necessary.

(9) Provide tight cover for pit to prevent interference with the ram by animals, etc.

(10) Fasten ram firmly to a solid base in pit.

(11) Put brass or copper screen over end of feed pipe in spring, not straight across the end, but bulged considerably.

(12) Keep this end of feed pipe off bottom of spring about 1 foot.

(13) Provide storage tank in top of house or mow of barn for storage of water from ram (see Fig. 25). Size will vary according to amount of water used, but probably an average would be about 4' x 5' x 5' or a capacity of 500.

WHAT TO DO IF RAM STOPS

There are only a few reasons for this, and usually it is a simple and inexpensive matter to correct the trouble.

(1) If water level in spring sinks to intake of feed pipe, not enough water may be getting in and, worse still, air may be entering the pipe.

(2) Air-dome may become water-logged for two reasons: Air valve may be choked or dome leaking above the water line. If this happens, remove dome to let out water and let air in. Fix air valve if out of order, and dome leak may be remedied by coating its inside surface with hot asphalt.

(3) Stem of waste-valve may stick for some reason, such as poor alignment, roughness of surface, or by reason of dirt lodging in it. If it becomes too badly worn a new one may be necessary. *Both waste and dome*

valves should be kept in good repair and clean to ensure continuous service.

(4) The adjusting nut on the waste-valve should be set at the best point for the amount of water entering the ram—shorter the stroke the less water, longer the more water required. Once adjusted properly seldom is it necessary to change it.

(5) Tests for valves:

(a) To test the waste-valve pull it up tightly and hold it for a moment. If on releasing it the valve remains closed and does not leak, one may rest assured that the valve is all right.

(b) To test the valve in the air-chamber, shut the water off the drive-pipe by closing the gate-valve near the ram, and hold the waste valve open. If delivery valve is leaking water will come out at the waste-valve.

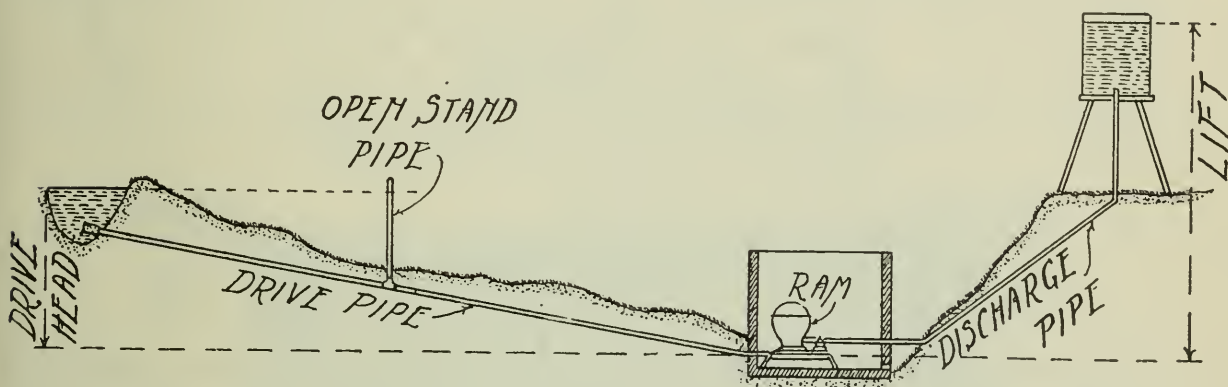


Fig. 26.—When the ram is at considerable distance from the spring, an open stand-pipe or reservoir must be provided within 35 to 50 ft. from the ram.

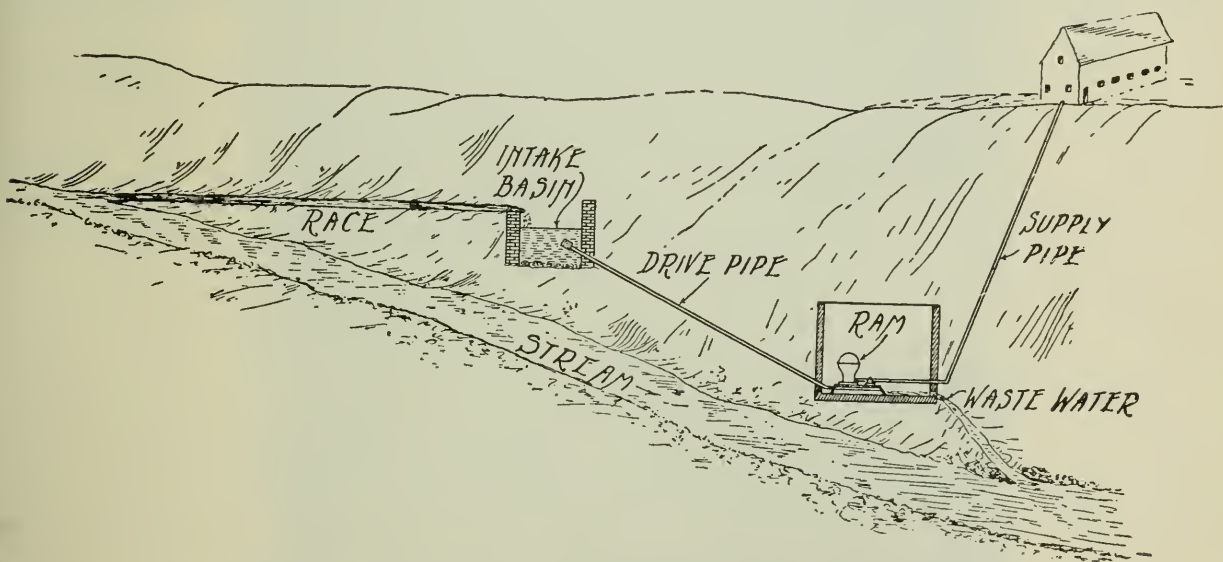


Fig. 27.—Obtaining head for ram along a river bank.

How to calculate how much water a certain Ram Outfit will pump:

The following rule is simple to apply. Multiply the intake to ram in gallons per minute by the amount of head or fall in feet and divide this product by the lift in feet, then multiply result by $\frac{65}{100}$ and by 60. The final result is the number of gallons pumped in 1 hour.

An Example:

With a supply of 10 gallons per minute and a fall of 6 feet, a lift of 60 feet, and an efficiency of 65%, the quantity pumped

Per minute = $\frac{10 \times 6}{60} \times \frac{65}{100} = \frac{65}{100}$ of a gallon,

Per hour = $\frac{65}{100} \times 60 = 39$ gallons,

Per day = $39 \times 24 = 936$ gallons.

USEFUL INFORMATION ABOUT THE STANDARD HYDRAULIC RAM

Sizes	Minimum Quantity of Water for Operation in Gals. per Minute	Length of Drive Pipe	Diameter of Pipes	
			Drive	Discharge
3	4	5 to 6 times the fall	1"	$\frac{1}{2}$ "
4	8		$1\frac{1}{2}$ "	$\frac{3}{4}$ "
5	14		2"	1"
6	25		$2\frac{1}{2}$ "	$1\frac{1}{4}$ "

COST OF A TYPICAL INSTALLATION

1 hydraulic ram #4 (standard)	\$28.00
50 feet of $1\frac{1}{2}$ " feed pipe (galvanized)	12.80
100 feet of $\frac{3}{4}$ " discharge pipe	11.06
1 $1\frac{1}{2}$ " gate valve	4.30

The total cost of any particular installation can be easily estimated from above prices once the actual lengths of the pipe lines are known. Other small items of cost are pit for ram, cribbing the spring, digging trenches and back-filling same for pipe lines and pipe fittings. A storage tank in the buildings is required, and it should be large enough, probably about 4 feet square and 4 feet deep, to contain 400 or 500 gallons of water.

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BULLETIN 399

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Ontario Department of Agriculture

Statistics and Publications Branch

TORONTO, ONTARIO

Plumbing and Sewage Disposal for the Farm Home

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An Adequate Bathroom is a Real Need in a Farm Home

ONTARIO AGRICULTURAL COLLEGE

GUELPH, ONTARIO

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PLUMBING

Explanation:—Plumbing is the art or trade of installing water supply and waste systems, in private and public buildings.

Is the Farmer interested? — Plumbing used to apply only to city and town buildings, but now the rural people are talking about it more and more, and many farmers are equipping their homes with plumbing systems. See Fig. 1.

PLANNING THE PLUMBING SYSTEM FOR THE FARM HOUSE

The following suggestions may be helpful to anyone considering the installation of plumbing:—

(1) *Dependable water supply is fundamental* — When a plumbing system is installed in a home a great deal more water will be used than before, so the first requisite is a constant and plentiful supply of water. If the supply is not satisfactory, the well should be improved before a pressure water system and plumbing are installed in the house.

(2) *Heating* — The house should be well heated by a hot air or a hot water system before plumbing is undertaken, in order to avoid much grief and expenditure due to frozen water pipes in our severe winters.

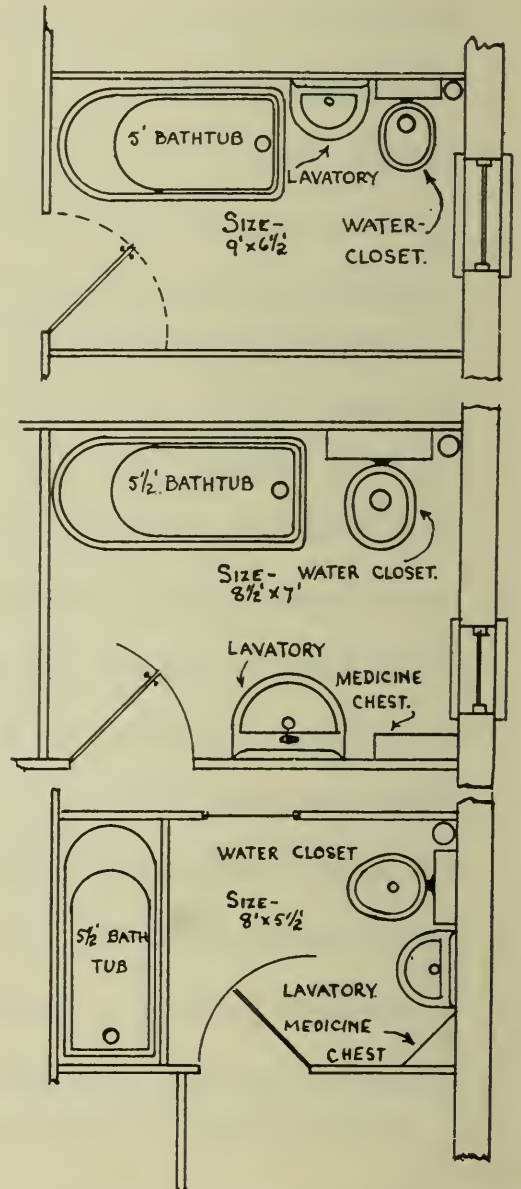
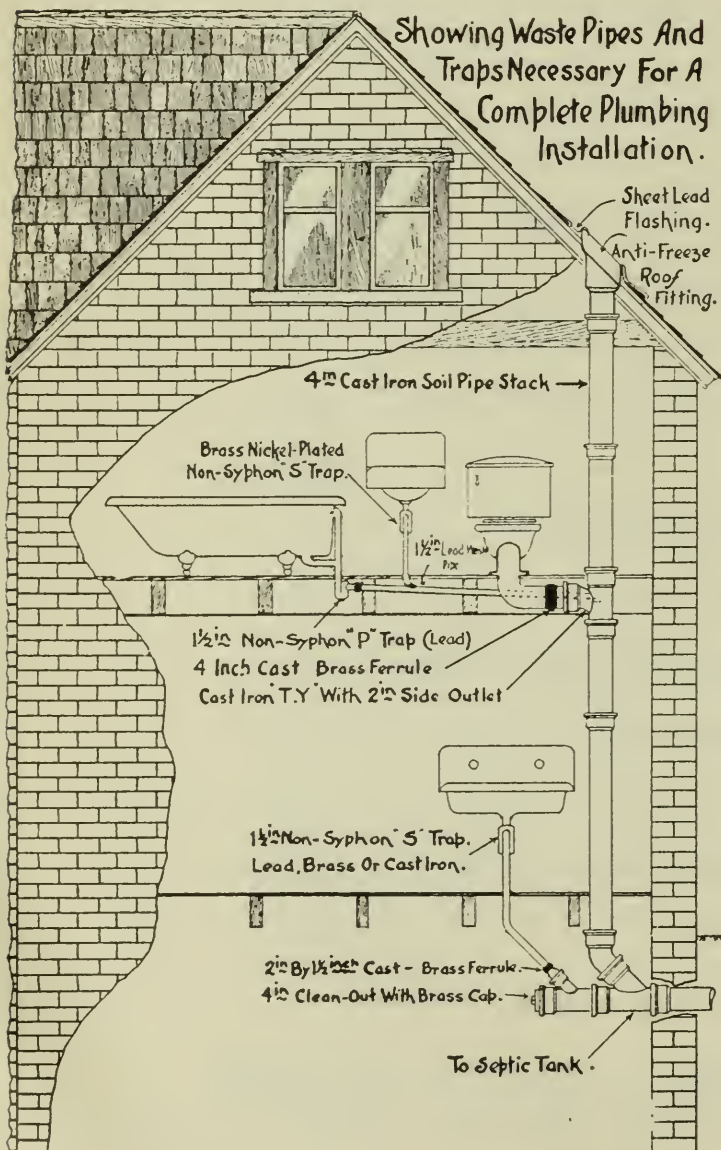


Fig. 1.—A sectional view of a plumbing system. Fig. 2.—Suggested layouts of bathrooms.

(3) *Locating the Bathroom* — In old houses it is not so easy to pick a suitable location as in a new one. The room need not be large, as illustrated in Fig. 2, the shape of the room and location of door and window having some relation to the minimum size. A small window, one end of a large central hallway upstairs, a large closet or a portion of an over-sized bedroom are possible selections. The South or East exposures are preferable to North or West for evident reasons. If bathroom can be located directly above the kitchen, or nearly so in case of two-storey houses, or close by it in case of a one-storey, a more compact and economical layout is possible, and one more easily protected against frost. The room should be well lighted and ventilated.

(4) *Arrangement of Fixtures* — The placing of the fixtures is largely dependent upon the shape and dimensions of the room, location of the door and window, the way the joists run, and whether or not a built-in bathtub is to be installed. This matter should be given careful consideration, in order to get the best and most convenient layout. Figs 1 and 2 may be helpful in this connection. Below is given the floor space (approx.) occupied by the individual fixtures and suggested layouts. *One very important principle is that the toilet should be located as near as possible to the stack.* A linen closet and medicine cabinet in the bathroom should not be overlooked.

Approximate floor space occupied by Bathroom Fixtures:

Bathtub—5, 5½ or 6 feet in length and 3 feet wide, overall dimensions.

Lavatory (basin)—24" wide x 22" deep.

Toilet Bowl and Tank combined—25" wide, 32" deep.

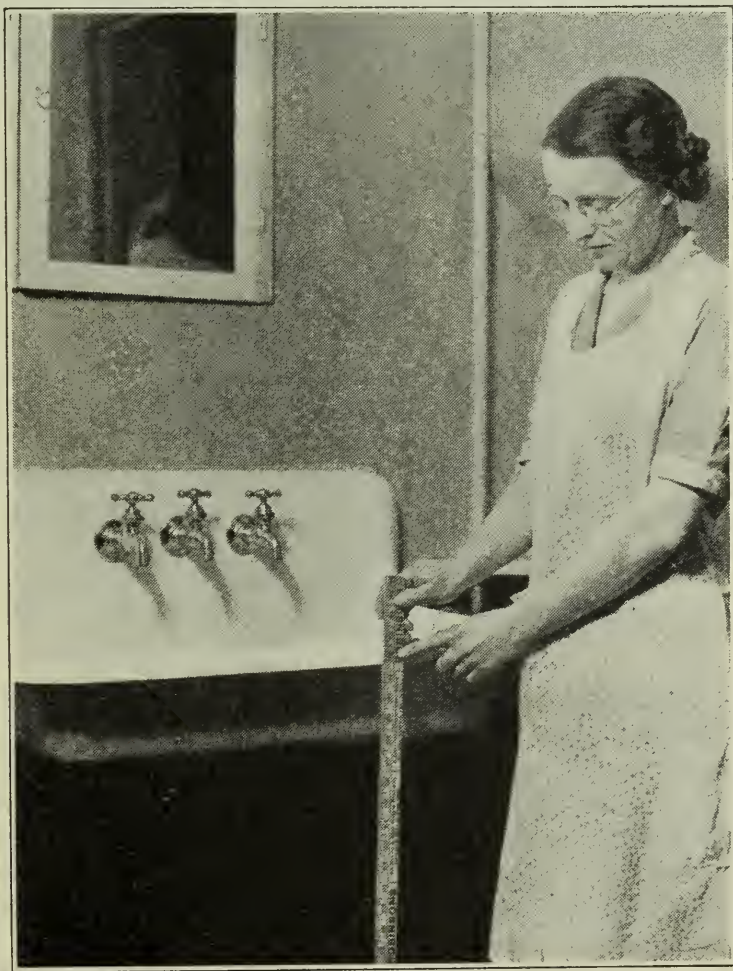


Fig. 3.—The height of the kitchen sink should suit the convenience of the women. Note the **three faucets** and the **good style** and **high quality** of the sink itself.

(5) *Best position and height for the kitchen sink*—The position varies of course, but beneath a window or close by is desirable, as that is usually the brightest and most cheerful place in the kitchen to work. Sinks with shallow backs can be had now, and this change in design is a distinct advantage in putting the sink beneath the window sill. The best height is that which enables the house-wife to work at the sink with the least stooping or lifting of her arms. Definitely she should be consulted about this detail. The measurement should be taken between the floor level and the top of the roll on the front of the sink. Usually the best height is about 34 inches. See Fig. 3.

(6) *Range boiler*—In the farm home the hot water boiler should be located in the kitchen and close by the kitchen range. See Figs. 7 and 15. This position ensures the minimum loss of heat, the quickest service where most of the hot water is used and hot water supply all the year round. *It cannot be located on a lower level than the heater to which it is attached*, but may be above or on the same level. The standard capacity for the boiler is 30 gallons, but in large homes, and where extra hot water is needed at times, a larger size, probably 40 gallons would be better. Farm homes equipped with electricity may use the "Hydro" flat rate heater, but the cost would be higher than heating by the kitchen range fired by wood from the farm wood lot. Much greater efficiency is realized if the boiler is insulated with 2 or 3 inches of hairfelt or mineral wool after the manner of the "Hydro" heater.

(7) *Wash room and toilet for men*—A small room on the ground floor of the house or in the basement, equipped with a toilet, wash basin and shower stall is highly recommended as a great convenience for the men folk. Off the kitchen would be a good location for this room, and many farm kitchens are large enough to provide space for it. *How refreshing would be a shower bath after a long, hot day spent in the fields or on the threshing floor!* See Fig. 4 for suggested layout with dimensions.

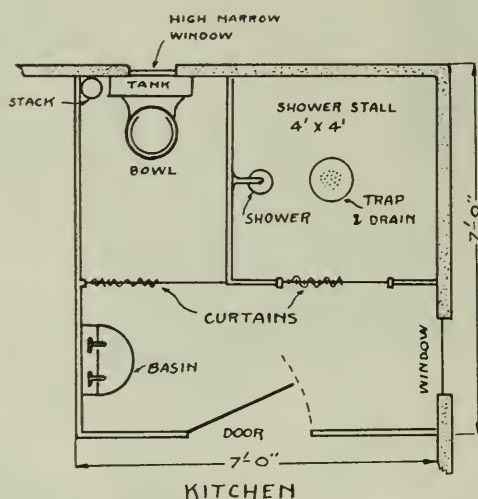


Fig. 4.—Shower, washroom and toilet for men.

(8) *Style and Quality of Plumbing Fixtures*—In the long run good quality and a reasonably modern style are desirable, since these fixtures are permanent in character, and have to last a long time. There are many styles and qualities from which to make a selection, and there are prices to suit all purses. In case of bathtubs the built-in and apron-to-the-floor-level on one side and one end are types preferable to the four-legged type from the standpoints of appearances, sanitation and ease in cleaning the floor. In respect to kitchen sinks it is very desirable that the basin and the back be continuous. A good size for the kitchen sink is 18" x 30" and it should be equipped with a drain board at each end, or one end at least. *As illustrated in Fig. 3 the sink should have 3 faucets, one for cold hard water, one for cold soft and the third for hot soft.*

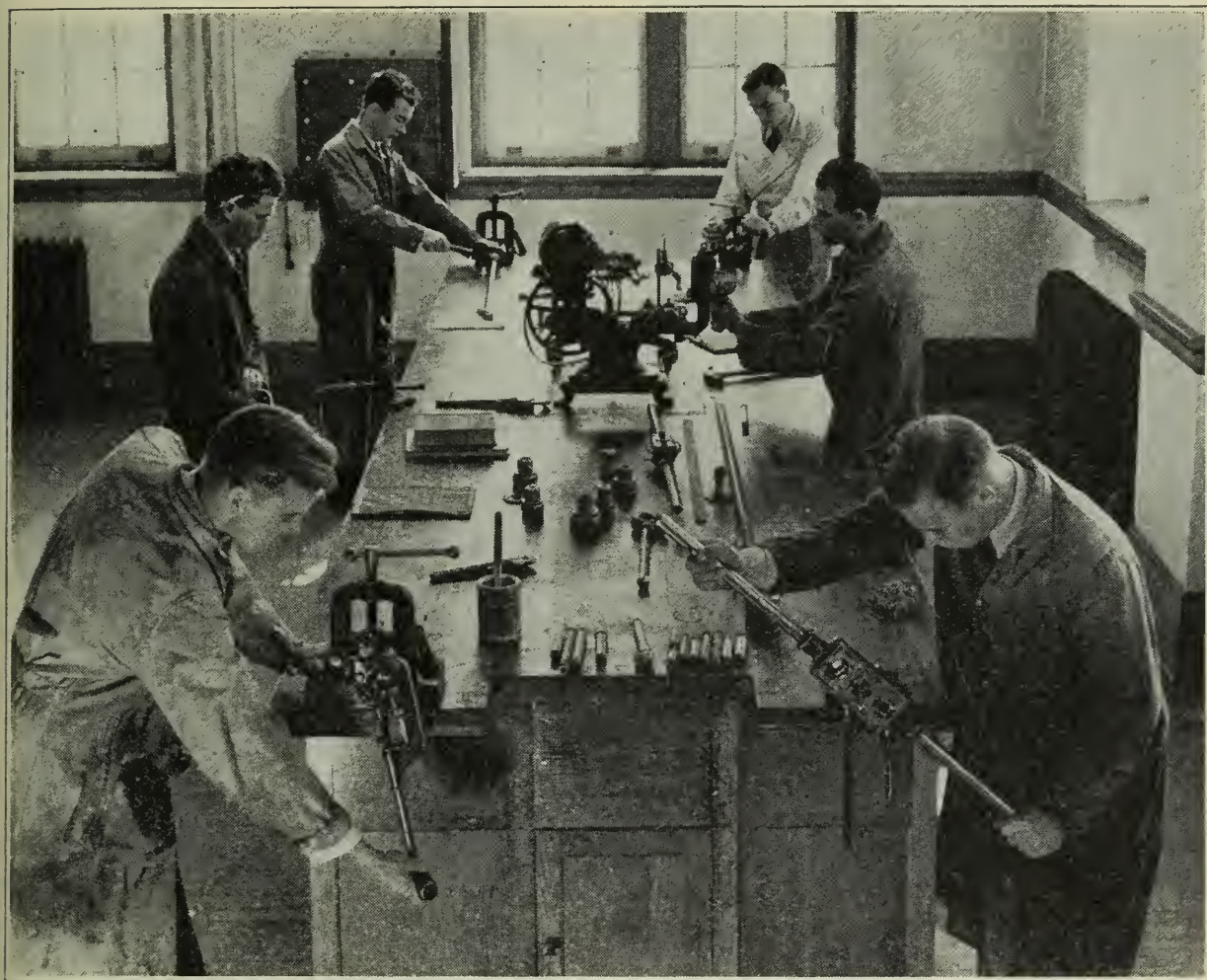


Fig. 5.—Students at the O.A.C. learn pipe fitting.

(9) *Plumbing Mechanic*—The installation of the water system, pipe lines for water supply, waste pipes for drainage, etc., should be done, for best results, by an experienced mechanic. After the pipe lines are installed they should be tested for leaks, and if any are detected they should be repaired. *This testing is very important because leaky and weak joints in the water or sewage lines may give much trouble from time to time.* If the farmer has some ability and training in plumbing he would find it to his advantage to assist the plumber, if time permitted, because he would become familiar with the system by so doing, and probably be better fitted to look after simple repairs from time to time, and to keep the system in better condition than if wholly ignorant of it. He may put in the plumbing himself if he be mechanically inclined, and is willing to acquaint himself with the principles, to secure facts and available helps on methods of operations, and in his work exercise great care and attention to details, but otherwise he should not consider the job at all.

Comments on Fig. 6:

1. *Cutting soil pipe*—Measure off length required and mark clearly; lay pipe on block of wood on floor; taking a heavy, sharp cold chisel and a hammer, cut a fine groove around pipe, then at one spot strike a heavy blow on chisel, and even off broken end.

2. *Fire pot for melting pure lead for caulking joints*—It is very important to study directions accompanying the fire-pot in order to understand how to operate it properly and how to correct any troubles that may arise.



Fig. 6.—Students at work on soil pipe operations.

3. *Caulking operation*—Centre the pipe in the hub, fill the space about $\frac{2}{3}$ full of oakum (hemp soaked in tar solution), ram the oakum into the hub well with yarning chisel, add a thin layer of molten lead by ladle, ram it down with flat end chisel, then completely fill the hub with lead and with a pair of caulking chisels (one outside, one inside) drive the lead well against the edge of pipe, and against the hub and remove any surplus lead with cold chisel. *Thoroughness and neatness are important features in this operation.*

4. *Testing the Joints for Leaks*—The students in this picture have used testing plugs for closing ends of the sample joint and subjected the joint to about 15 pounds pressure, the equivalent of a column of water 35 feet tall. The joints in the completed stack may be tested by plugging all openings except the top one, and filling the stack with water. Smoke is sometimes used in place of the water.

Facts About Soil Pipe:

Soil pipe is a cast material and used for conveying sewage and waste liquids. It is made in 5-foot lengths in both the single and double hub form. The plumber in house plumbing jobs usually finds it some advantage to order 2 or 3 lengths with hubs on both ends (double hub). The 4-inch size is used for building the stack and the 2-inch size for waste pipes. The medium weight is used for house plumbing, it being 45 pounds per 5-foot length for the 4-inch size.

Common Soil Pipe Fittings:

In house plumbing these occur in 4-inch and 2-inch sizes and also in combinations of these two sizes. The common ones are—4 x 4 T-Y, 4 x 2 T-Y, 4 x 4 Y, 4 x 4 T, 4 x 4 x 2 T-Y special (both right and left), $\frac{1}{4}$, $\frac{1}{6}$, $\frac{1}{8}$, and $\frac{1}{16}$ bends in both 4" and 2" sizes, 2 x 2 T, 2 x 2 Y.

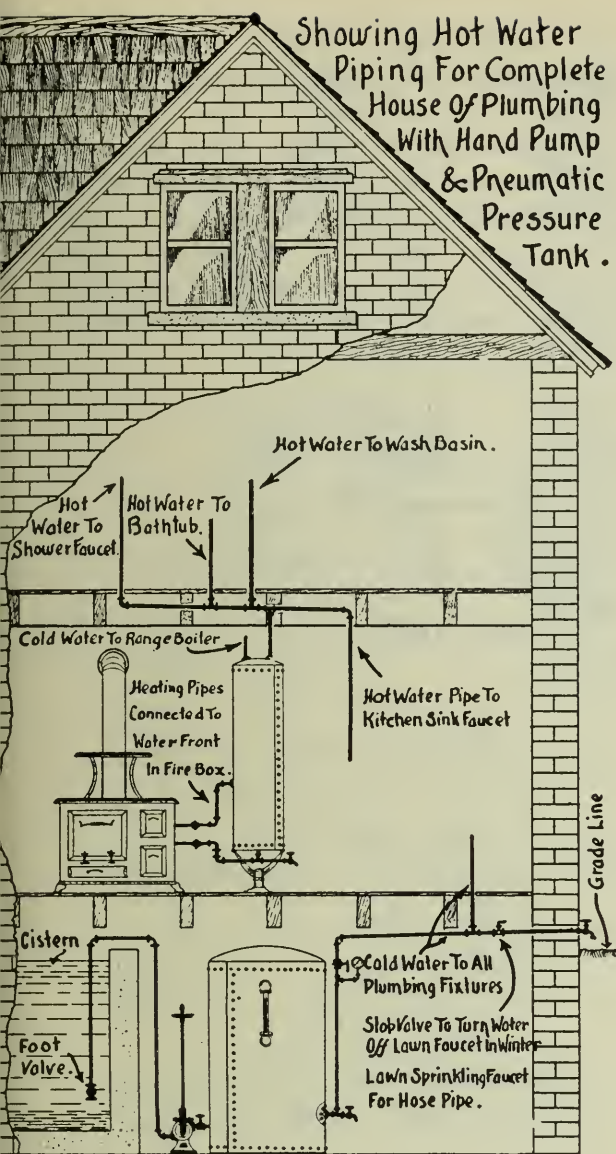


Fig. 7

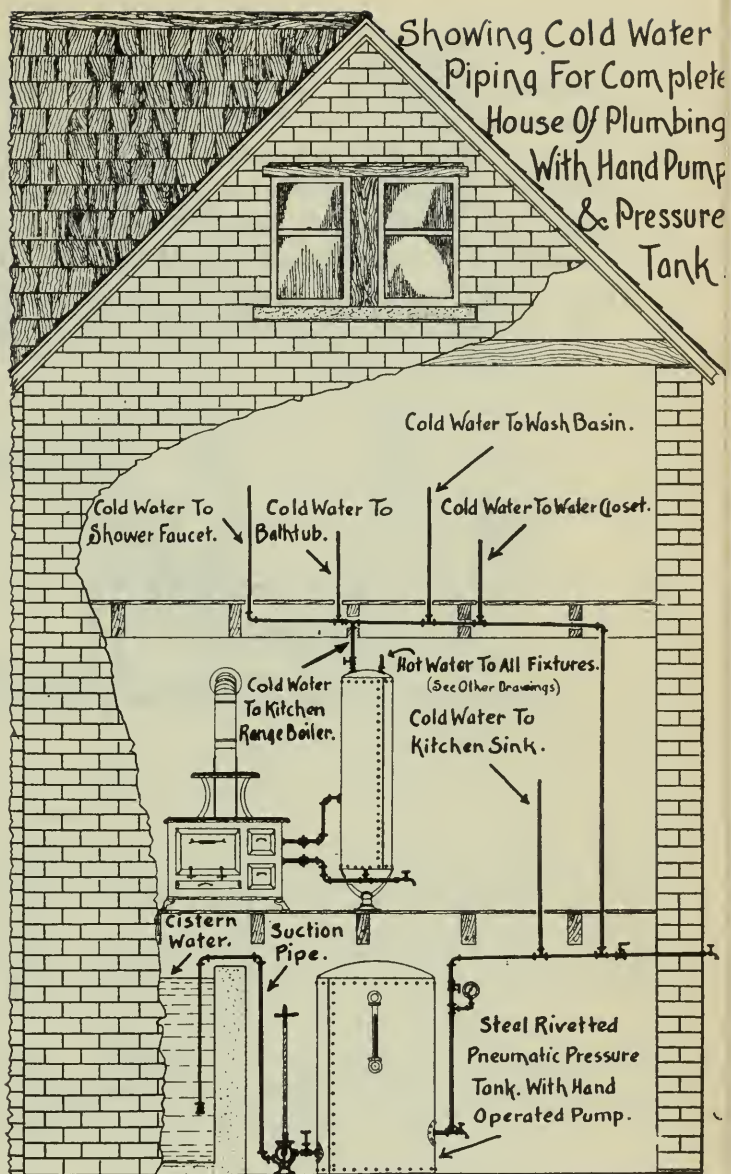


Fig. 8

Comments on Figs. 7 and 8:

The pressure system shown in these illustrations is operated by a hand pump, and it is the best type of system where power is not available; a system much preferred to the attic tank systems used in the past. The hand pump may be changed at any time to an electrically operated pump when "Hydro" is installed. A small pedal-starting gas engine may be used, but it is somewhat objectionable for inside use on account of the noise, and the exhaust fumes which have to be taken care of by a pipe carried out-of-doors.

The main purpose of the illustrations is to show clearly the method of laying out the hot and cold water lines, the range boiler, pipe connections for water system, etc. It is very important to provide for a compact and well arranged system of pipes, for economy's sake, and the pipe lines should be located in partition walls in preference to outside walls for greater protection from frost. A heavy covering of hairfelt (2") is an effective protection for water pipes in badly exposed places in houses. The reader is referred to Fig. 7 for details of range boiler installation; the boiler is supplied with cold water by means of a pipe extending well to the bottom of the boiler, the range boiler is put close to the stove or furnace, and the size of pipe between boiler and stove is $\frac{3}{4}$ ". The main pipe lines are $\frac{1}{2}$ " in diameter, and the quality should be best quality galvanized iron. The joints and all connections should be perfect and they should be tested well for leaks after installation.

4. *Traps*—These are water seals in the waste pipes, located close to the fixtures, and their purpose is to prevent sewer gases and odors escaping into the house at the drains in the bottom of the fixtures. In the case of the toilet the trap is built into the base of the bowl and remains full of water after flushing. There are many styles and qualities of traps, some common ones being shown in Fig. 9. Styles a, b and c are well suited for kitchen sinks and laundry tubs; c and d for wash-basin (lavatory) in bathroom; and e and f for bathtubs. *They are very important parts of the plumbing system, for however perfect otherwise the system may be, it is useless without them from sanitary and health standpoints.*

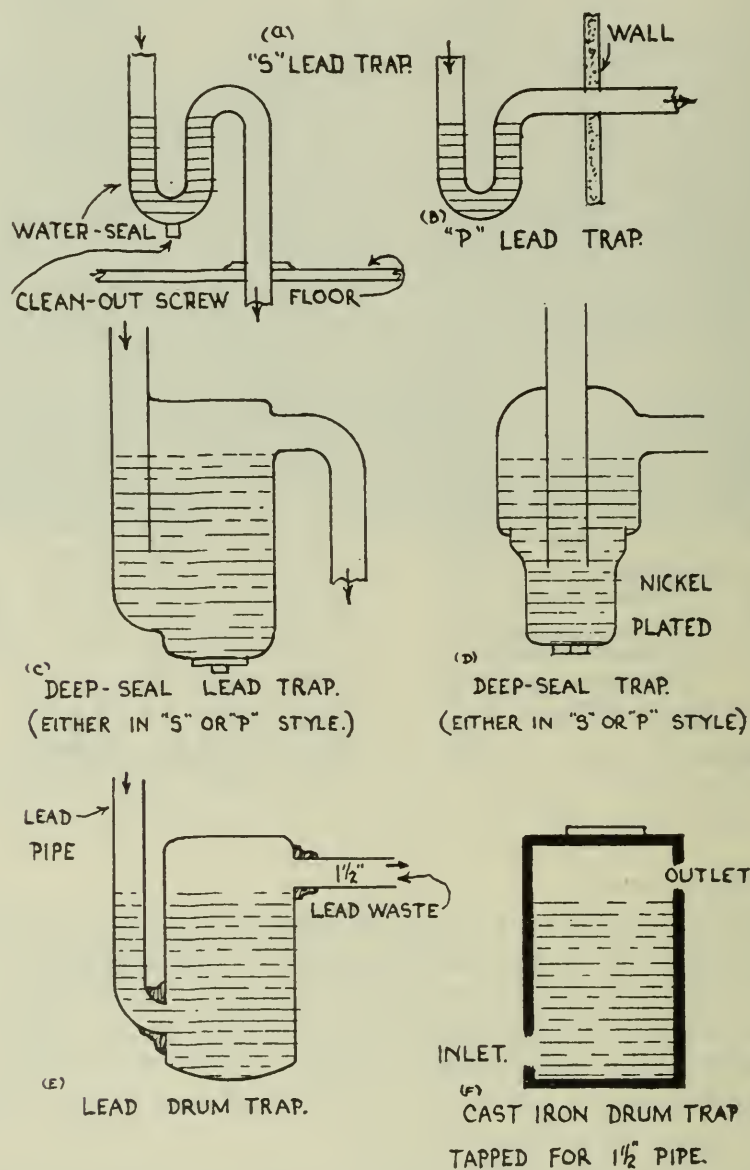


Fig. 9.—Common styles of Traps.

Traps should be located as close as possible to the fixtures, in order to seal practically the whole length of the waste-pipes. They should be kept free of waste particles and clean, so that the waste-water can flow away quickly and make cleaning of the fixtures an easy mttter. A plug at the lower end of the trap is a great convenience for thorough cleaning and it should be opened up more frequently than is usually the case.

BRASS FITTINGS

The most common ones used in installing pumps, hydraulic rams, plumbing systems, compression water systems, range boilers, etc., are:

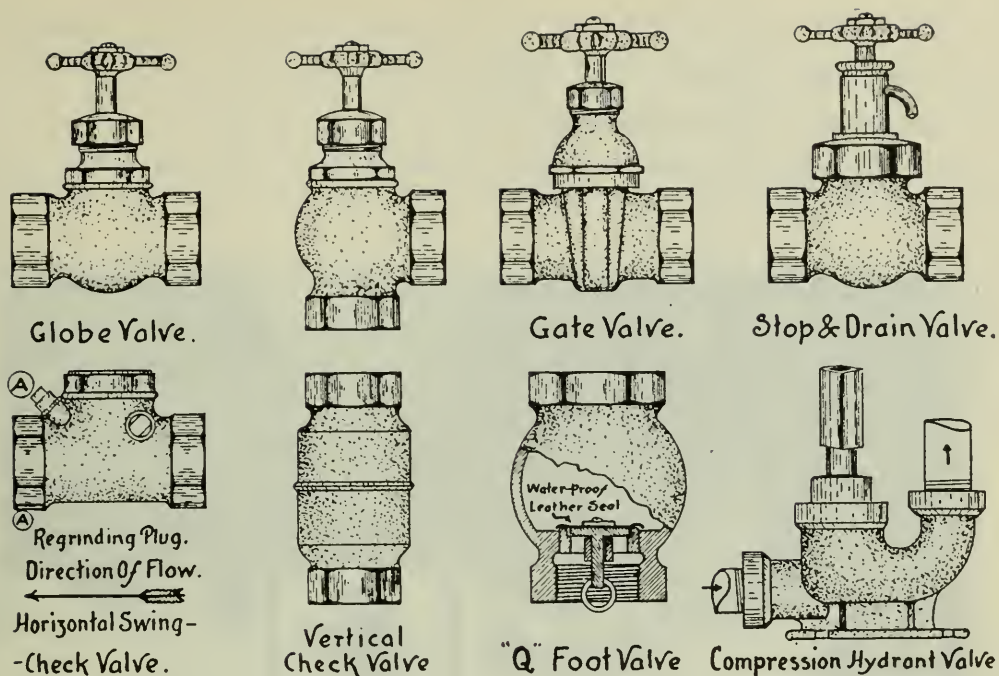


Fig. 10.—Globe, angle and gate valves, horizontal and vertical check valves, stop and drain valve, foot valve and compression hydrant valve.

1. *Gate valve*—This has two special uses; one on the feed pipe of the hydraulic ram, and the other on the pipe between a compression pump and the tank.
2. *Globe valve*—It is used for a tight fitting and high pressure valve control. In a house plumbing system it is commonly used on the supply pipe of the range boiler at a point close to the top of the boiler, see Fig. 8.
3. *Angle valve*—It is very suitably used on the discharge line between a compression pump and the tank at the point where the line connects to the tank, the handle of the valve being in line with the pipe.
4. *Check valves*—They may or may not be made entirely of brass. They are used at the end of suction lines to keep the line primed. There are both horizontal and vertical types.
5. *Stop and drain valve*—Its use and position is indicated in Fig. 7. It serves two purposes; one to shut off flow of water from pressure tank, the other to drain the pipe lines above the pressure tank. Another common use is to control the flow of water to the lawn service and drain the pipe line outside the wall, see Fig. 7. The one shown in Fig. 10 has a bent drain pipe, but there is another and a better type that has a control on the drain pipe, a small screw cap. The advantage of this one over the other shown in Fig. 10 is that the pipes above the pressure tank need not be drained if cap is closed.

PLUMBING TOOLS

No farm workshop should be considered as complete without a fairly good set of plumbing tools. In Figs. 6 and 11 the standard ones are illustrated. In Fig. 5 students are shown at work with pipe fitting tools, and in Fig. 6 with soil pipe fitting tools.

Key to list of Tools: (Fig. 11):

1. Trio or three-in-one stock and dies.
2. Ratchet type of stock and dies.
3. Pipe cutter.

4. 14-inch pipe wrench.
5. 10-inch pipe wrench.
6. Pipe reamer in ordinary brace.
7. & 8. Pipe vises.

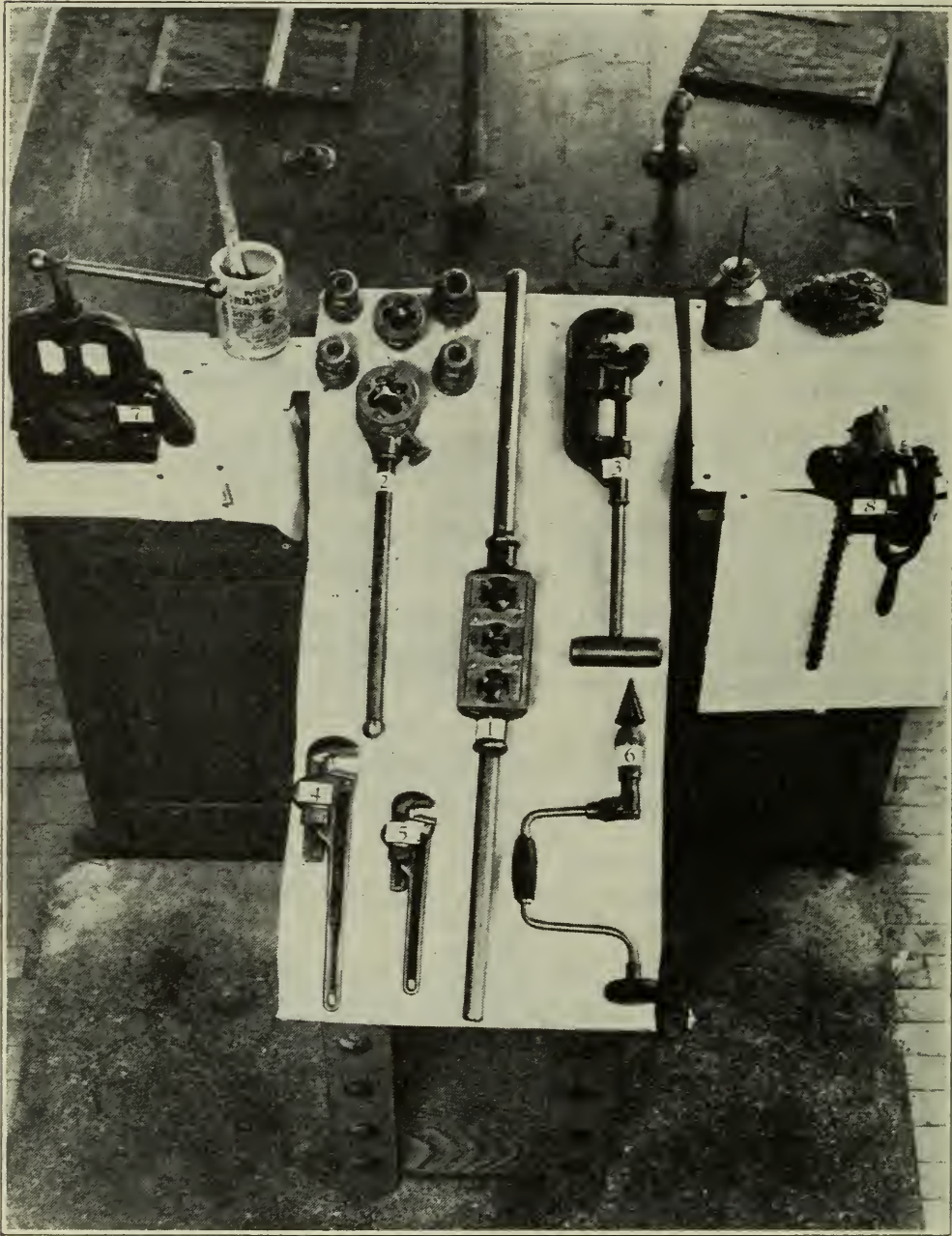


Fig. 11.—Some common Plumbing Tools.

FACTS OF INTEREST TO THE AMATEUR PLUMBER OR ANYONE WHO WISHES TO INSTALL HIS OWN PLUMBING SYSTEM

Fig. 12 shows the details of the layout of *water supply lines and waste-pipes* with their connections for a bathroom where wrought iron pipes are used for waste pipes instead of lead and cast-iron, where the 4-inch lead bend with iron thimble (ferrule) inserted is used instead of the standard 4-inch lead bend with brass thimble wiped on by an experienced plumber for the waste-pipe from the toilet. The latter method is illustrated in Fig. 14. The iron drum trap Fig. 12

(h) and Fig. 9 (f) is a good type of trap for this system. For elbows in the iron waste-pipes the cast iron drainage elbow is the proper one to use as it does not choke so easily with dirt as the ordinary elbow. Note the cross-over fitting making it possible to lay on the same level pipe lines that cross each other. If possible the bathroom fixtures should be planned to avoid the cutting of joists, particularly in case of the larger drain pipes. Another simplified method for connecting the toilet to the stack is by use of the so-called "Boosey" bend which is a 4-inch cast-iron pipe tapped with two $1\frac{1}{2}$ " connections for wrought-iron waste pipes, one for the bath and the other for the wash-basin.

In caulking 4-inch lead bend, Fig. 12 (d) into cast-iron fitting, great care is required to protect lead pipe from drops of hot lead by laying heavy paper over the lead pipe.

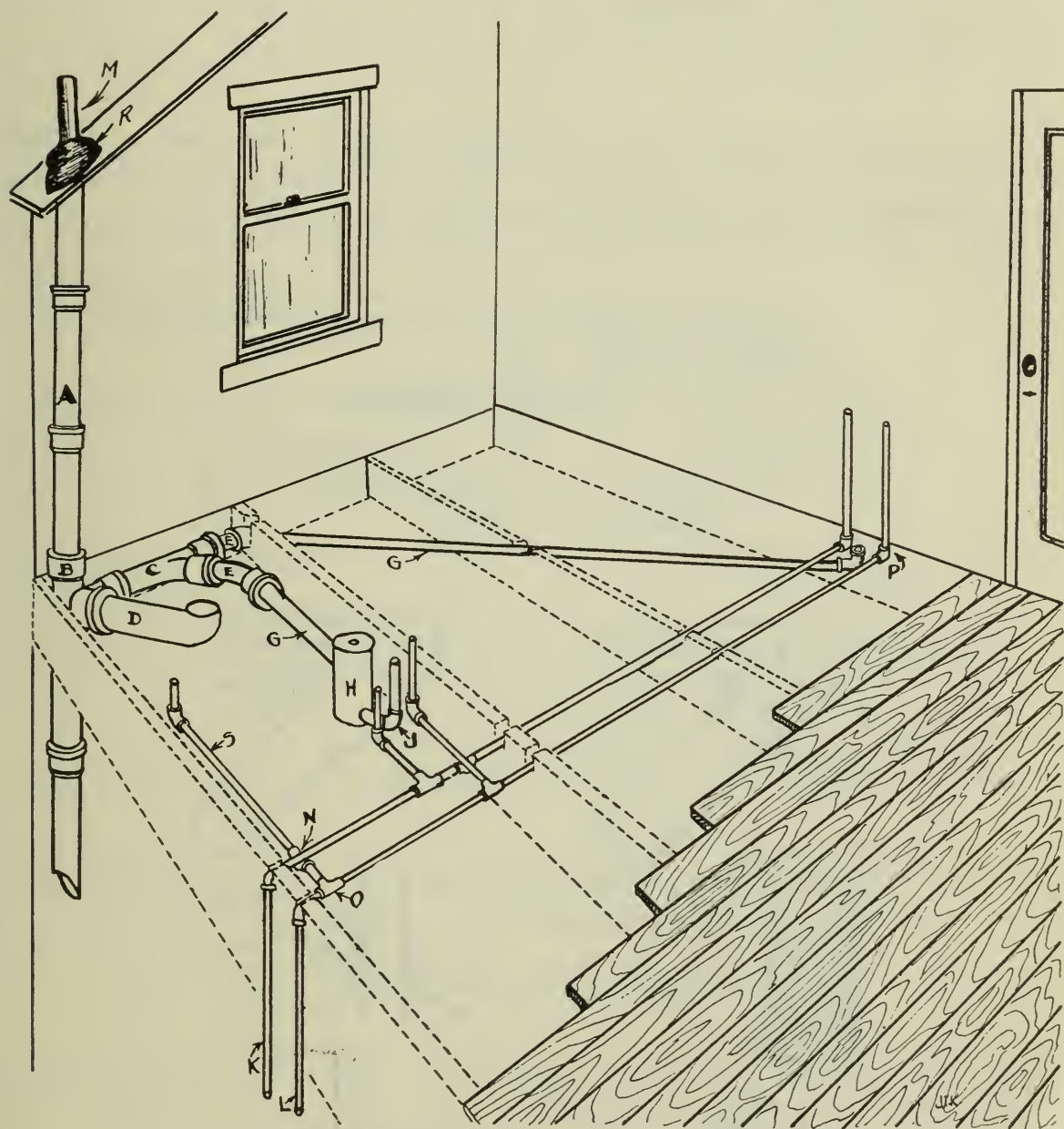


Fig. 12.—Simplified layout of bathroom waste-pipes.

Key to parts:

A—4-inch cast-iron soil pipe—the stack.

B—4 x 4 x 2 special cast-iron fitting.

C—2 x 2Y fitting.

D—4" lead bend waste pipe with iron ferrule inserted by the manufacturer.

E—2 x $\frac{1}{8}$ bend.

G—1½-inch wrought iron pipe.

H—Cast-iron drum trap with threaded connections.

J—Trap connection to waste pipe for toilet using cast-iron drainage elbow.

K—½-inch hot water pipe line.

L—½-inch cold water pipe line.

M—Stack vent.

N—½-inch cross-over.

O—½-inch tee.

P—½-inch elbow.

R—Roof flange for stack pipe.

S—Pipe to closet tank.

In Fig. 13 are illustrated some of the more difficult connections in the bathroom, namely, toilet connections, slip joint connections of drain pipe of wash-basin to drain beneath the floor, roof flange to stack, etc.

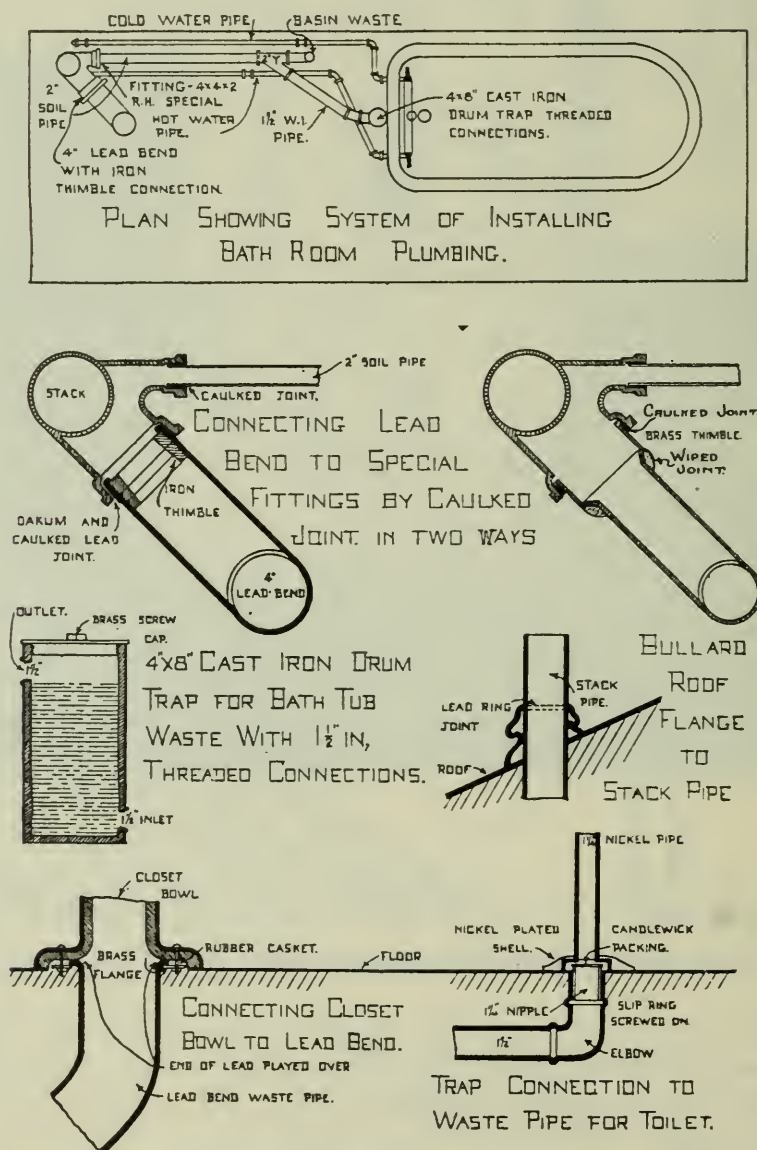


Fig. 13.—Special connections of a Plumbing System.

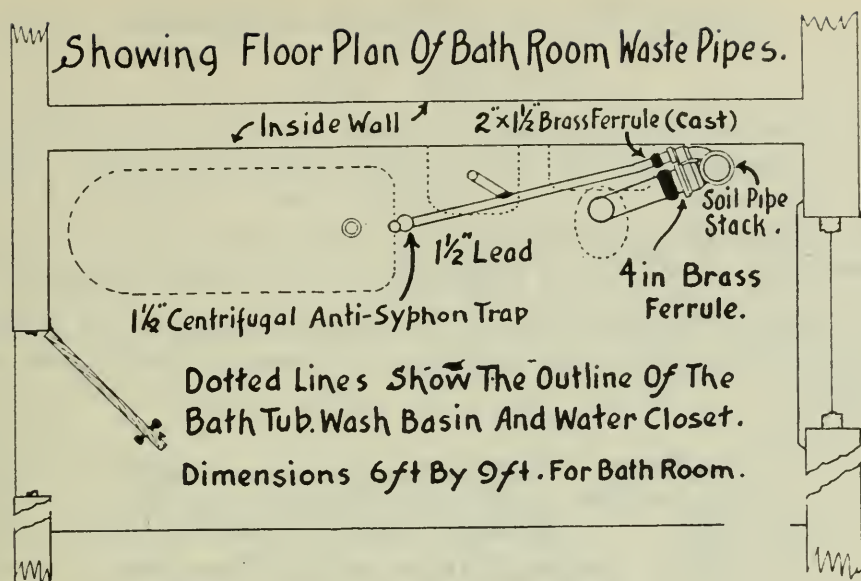


Fig. 14

HOT AND COLD SOFT WATER SYSTEM FOR KITCHEN SINK

The system illustrated in Fig. 15 is adapted only to farm kitchens not equipped as yet with running water.

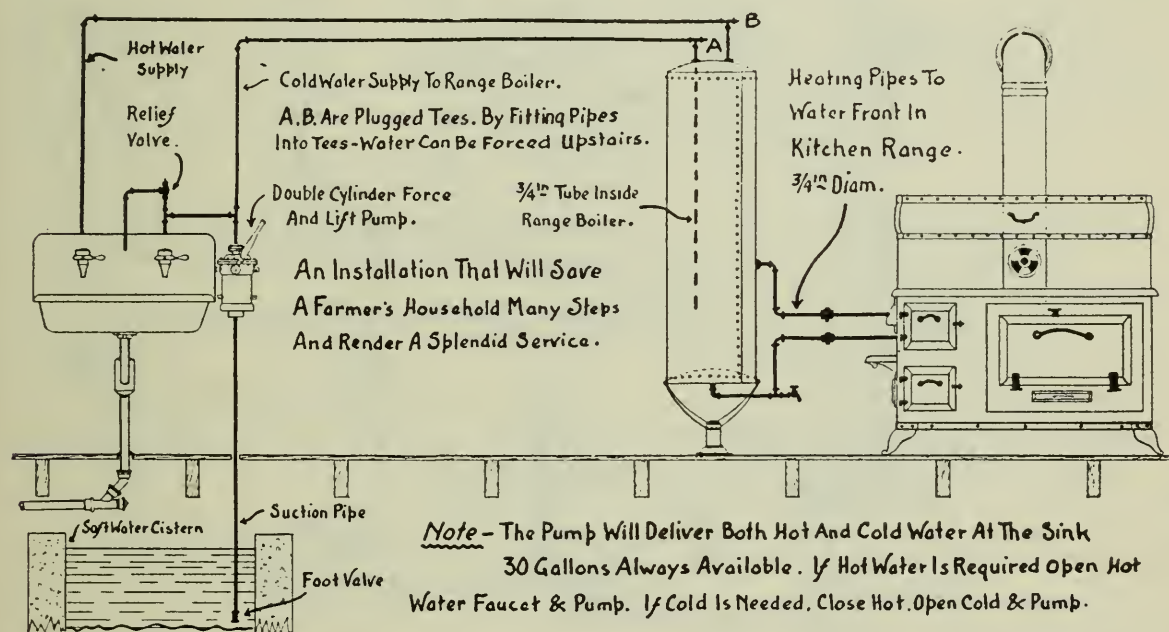


Fig. 15.—A simple hot water system—cistern pump connected to kitchen range boiler.

It is a great improvement on the old system of heating the soft water in a copper tank attached to the rear of the kitchen range as it eliminates entirely all carrying of water from pump to stove and back again to the sink, and a larger quantity of hot water can be kept on hand. When a pressure water system and plumbing are installed in the home the equipment may still be used with only slight alterations. *The introduction of this simple system might lead sooner or later in many cases to a complete plumbing system in the home*, as illustrated in Fig. 1. Any type of force pump may be used.

If interested, write Department of Agricultural Engineering, Ontario Agricultural College, Guelph, for a blue-print.

SYSTEMS OF SEWAGE DISPOSAL

THE SEPTIC TANK

When the farm home is equipped with running water and a complete plumbing system, it is necessary to provide for a sewage disposal system. The approved method is the septic tank. There are various types of septic tanks but the two most common systems are the double-chamber with siphon and the single-chamber without siphon, both of which are described and illustrated herewith.

The septic tank is recognized by all Provincial Boards of Health and sanitary engineers as the best system for disposing of sewage from rural, village and suburban homes.

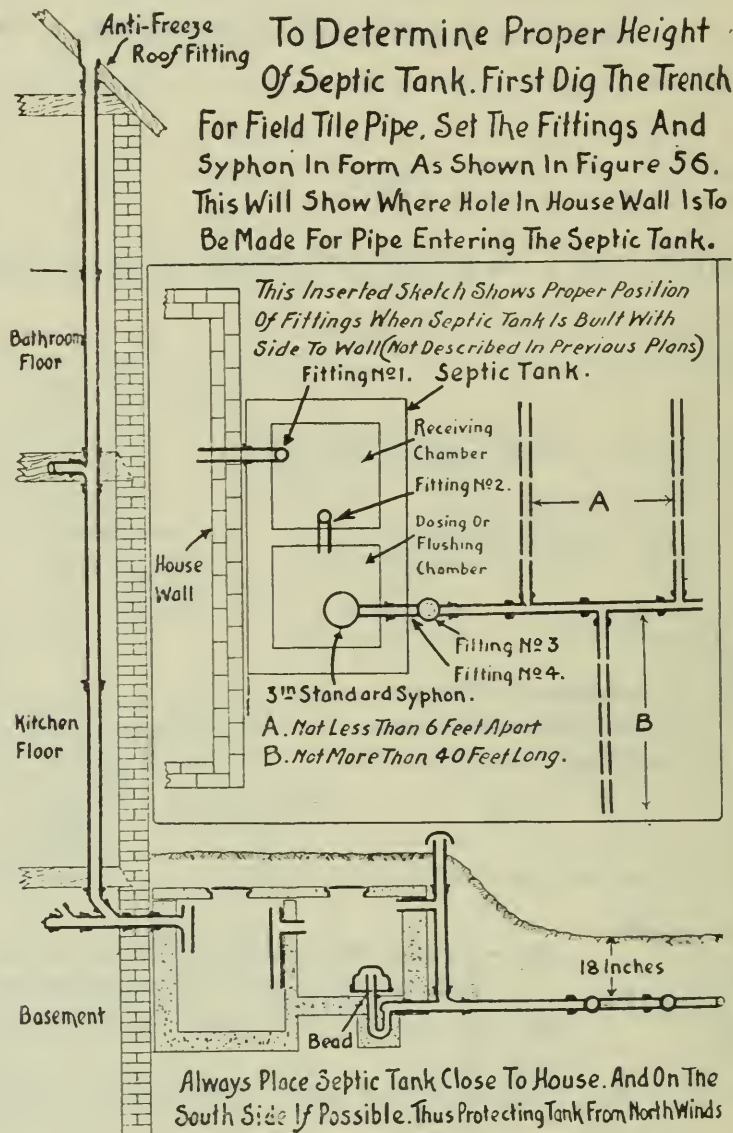


Fig. 16

GENERAL DESCRIPTION

Briefly stated, the septic tank is a two-chamber tank or a single receptacle for receiving the sewage and holding it until digested by sewage bacteria; and a system of field tile connected thereto, and laid under ground for disposing of the liquid effluent discharged from the tank from time to time. For the most part the sewage is destroyed in the receiving chamber; however, there is some bacterial action in the other chamber. Sewage bacteria also live in the upper layers of the soil and assist in destroying any raw sewage that may pass through the tanks into the tile. The chief products of the bacterial action in the tanks are gases and

water. Disease germs may survive the action in the tank, but ultimately they succumb in the soil, and if there is plenty of soil between the absorption bed and the well there is not much chance of the water being contaminated. The sewage bacteria operating in the tanks do not require oxygen, whereas those in the soil do, and this is one good reason why the tile are laid shallow.

(a) THE TWO-CHAMBER SYSTEM WITH SIPHON

The function of the first or receiving chamber is to retain the sewage until it is digested by bacteria; that of the second or dosing chamber is to collect the overflow from the first chamber, therefore, it is part of the distributing system. The intermittent discharge from the second chamber is made possible by an automatic siphon located in the bottom of this chamber. This system is particularly well adapted to medium and large installations such as large homes with more than 12 people, schools, hospitals and other public institutions in unseweraged districts; but for farm homes the second chamber and the siphon are not absolute necessities as the effluent can usually be disposed of satisfactorily without a siphon. See Figs. 17 and 18 for details of construction.

CONSTRUCTION OF THE TANK

As a rule it is of concrete construction, a 1 to 6 mixture being used. The plans (Fig. 17) and the subjoined table supply the necessary information as to dimensions, thickness of walls, amounts of gravel and cement, etc. The forms are simple and easy to build, and outer ones are not necessary except above the surface. The forms should be made true, and be well braced. The fittings should be placed in the forms at positions indicated in Fig. 18 and before the concrete is run into the forms. The U-part of the siphon should be placed vertical and near the outer end of the chamber, and with the bead on a level with the finished surface of the floor, as shown in the section part of Fig. 17.

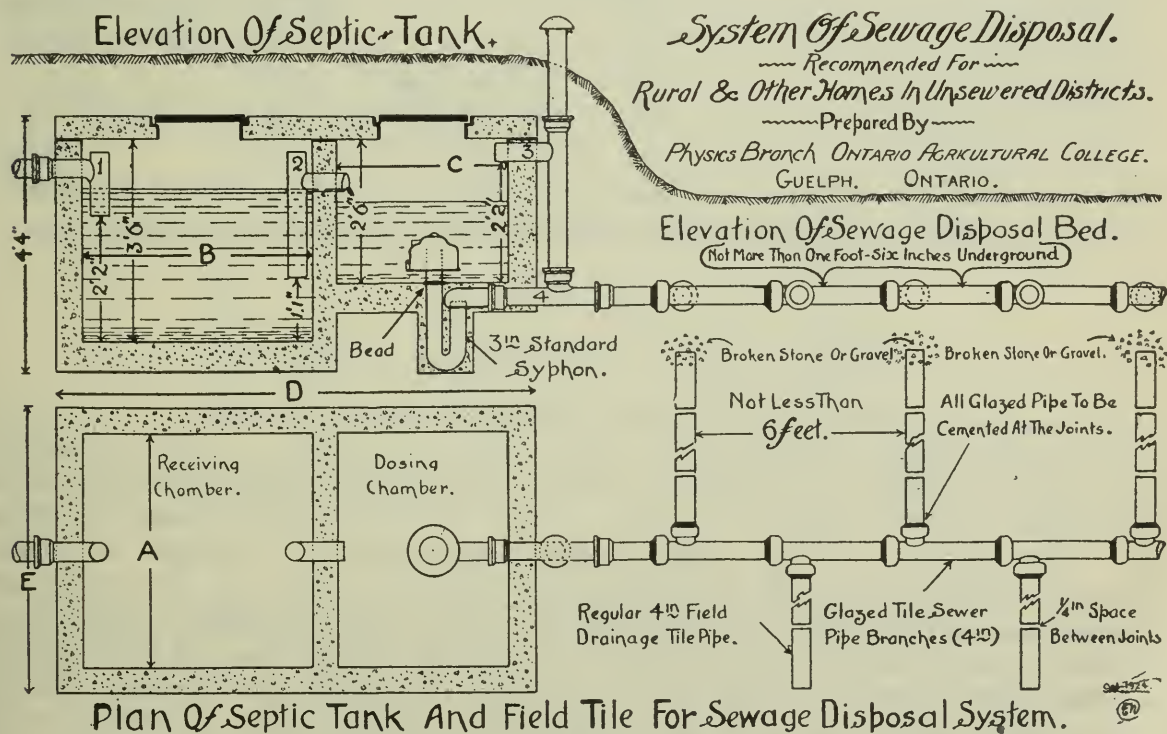


Fig. 17

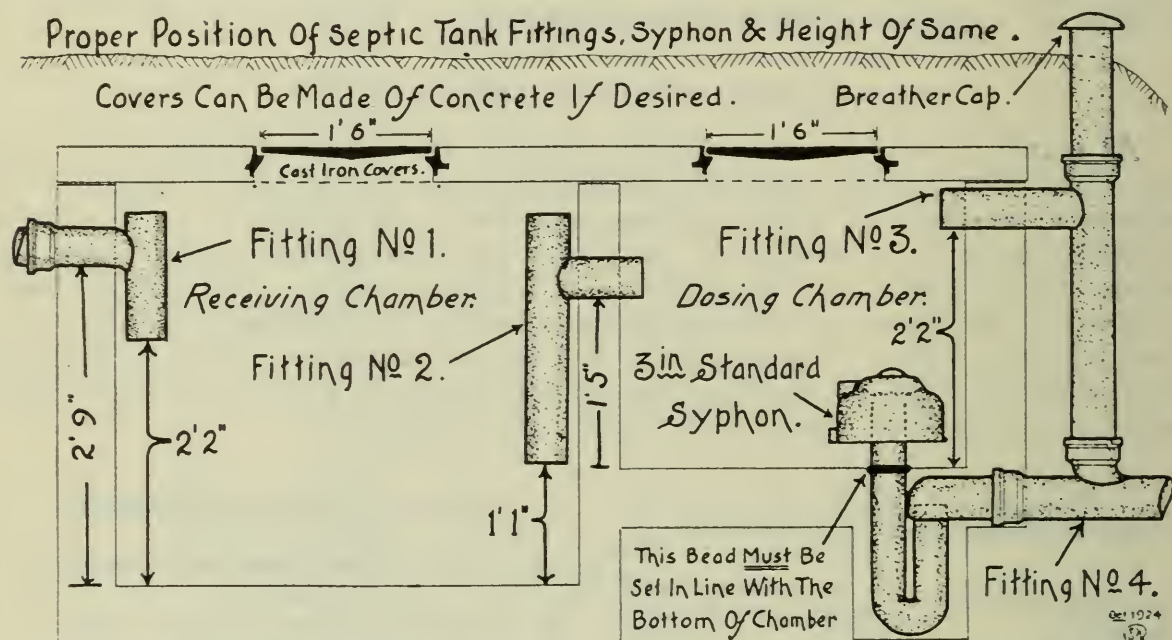
The entrance to the vertical tube of the siphon should be plugged to keep objects from falling into it during the construction of the system. After the forms have been removed, the interior surfaces should be plastered with rich cement

mixture (one to one) to make tank water-tight. After this the top or cover is constructed with accommodation for two manholes. In the top of the partition wall there should be two or three openings to permit of air passing from one chamber to the other unless standard fittings as shown in Fig. 18 are used, when openings may be omitted.

Special Notes:

(1) The vent pipe shown in the three Figs. 16, 17, 18 may be omitted with some advantages, but the vertical pipe connected to the main and leading into the top of the dosing chamber should be retained, in order to give circulation of air between the absorption bed and the septic tank.

(2) In Fig. 17 it is stated that the joints in the main should be cemented, but should they ever need to be taken up it would be better to omit the cement and fill the joints well with oakum and pack about with clay.



Showing Exact Position Of Standard Septic Tank Syphon And Fittings Nos 1, 2, 3, And 4. Irrespective Of The Size Of Septic Tank - All These Fittings Are 4" Cast Iron Soil Pipe Size.

Fig. 18

CONSTRUCTION OF THE ABSORPTION BED

An area of ground about 25 feet by 50 feet is required for the bed or system of tile for the average-sized home. If the soil be very heavy or apt to become water-logged it should be tile-drained first by putting two parallel rows of three or four-inch tile at a depth of two and a half feet and joining them to a good outlet. The main line of tile of the absorption bed may run through the centre of the area or along one side. The branches should be at least six feet apart and not more than forty or fifty feet long, and the joints with one-eighth inch opening. The whole system should be practically level and not deeper than 18 to 24 inches, depending upon whether soil be heavy or light. The joints in the main should be well caulked with oakum but not cemented, as stated above. Vitrified sewer pipe is used for the main, and four-inch field drainage tile for the branches. In heavy soil a few inches of cinders, gravel or broken stone should be put around the tile to assist drainage, as illustrated in Fig. 19, and piles of small stones at ends of laterals for air supply, and the trenches in clay soil should be made at least 18" wide.

The system of tile may be laid in terraced or sloping ground if necessary, but it is not a common occurrence. *Diagram for such a layout may be obtained upon application, if required.*

Data Regarding Size and Construction of Double-Chamber System

Number of Persons to Occupy House	Reference Letters See Fig. 17										Lineal feet	Materials required using 1-2.4 Mixture	
	A		B		C		D		E		Field Tile		
	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	4 in.	Sacks of Cement	Loads of Gravel
Four	3	6	4	0	3	0	8	4	4	6	150	16	3
Six	4	0	5	0	5	0	11	2	5	0	285	22	5
Eight	4	0	6	0	6	6	13	10	5	0	375	26	6
Ten	5	6	5	6	6	0	13	4	7	0	470	35	8
Twelve	6	6	6	6	6	6	14	10	8	0	605	58	12

Note.—Six-inch walls for the first three tanks and 8-inch walls for the last two.

TANK FITTINGS

These parts comprise the siphon, the inlet, the overflow in the partition wall, and the ventilation pipe, all clearly shown in Fig. 18. The siphon is commonly known as the Miller design, and may be purchased from plumbers or hardware men. The other fittings may be assembled on the spot from pieces of four-inch cast-iron pipes, or they may be purchased as standard tank fittings similar to those shown in Fig. 18. The complete set, including the 3-inch siphon, costs about \$35. It is very essential to have all fittings correctly installed, and for this reason Fig. 18 is shown with all details and measurements emphasized.

The siphon empties the second chamber automatically when liquid gets about sixteen inches deep. It helps in keeping the tile system flushed out and ventilated and thereby making conditions in the soil more favourable for bacterial action. The U-part of the siphon should be filled with water, or primed, before the bell is set on. The breather shown in Fig. 17 may be omitted, a 90° elbow being used instead of a "T" marked No. 3, Fig. 18, at the point where vertical pipe turns into tank.

Sizes of the Standard Septic Tank Siphon (Miller Type)

- For 5 to 15 persons use 3-inch siphon
- For 16 to 40 persons use 4-inch siphon
- For 41 to 100 persons use 5-inch siphon
- For 101 to 200 persons use 6-inch siphon
- For 201 to 1000 persons use 8-inch siphon

The large sizes are used for septic tanks for schools, hospitals and other large institutions in rural districts.

LOCATION OF TANK

The tank should be placed near the house, and preferably on the south or warmest side. If convenient, it may be put tight to the foundation wall, either endwise or sidewise, as shown in Fig. 16 tar paper being placed between the two walls. If the system be properly installed there should be no odour from the tank. The tank should be easily accessible for the purpose of cleaning out when necessary. The top should be kept covered with about 12 to 18 inches of soil or turf.

LOCATION OF TILE SYSTEM

The absorption bed may be laid under the flower or vegetable garden, the lawn or any convenient place near by. It should be kept away, as far as possible,

from the water supply and roots of bushes and trees, and at least 15 to 20 feet from the house. The tile system may be laid out in various ways.

WHERE TO BEGIN IN LAYING OUT THE SYSTEM

The purpose of Fig. 16 is to show the connection of the system to the soil pipe in the house, on the one hand, and the lay of the land about the house, on the other. According to it, the depth of the trenches for the tile should be determined first of all; then the bottom of the excavation of the siphon chamber should be fixed a few inches higher; then if the fittings are placed at their proper positions, as shown in Fig. 18, the point where the soil pipe passes through the foundation wall is automatically determined. If the land is quite level, the tank when finished will project some above the ground level; if so, it will be necessary to bank up and cover.

(b) THE SINGLE-CHAMBER TANK

This system has only one chamber but usually there is a baffle wall or two inside of it to keep the contents of the tank as quiet as possible, thus promoting the sedimentation of the solids. The tank should be at least 4 ft. deep, and have a capacity of about 10 cu. ft. per person. Oblong is the best shape, and the length should be $1\frac{1}{4}$ to $1\frac{1}{2}$ times the width. The most durable and satisfactory construction is concrete if well constructed.

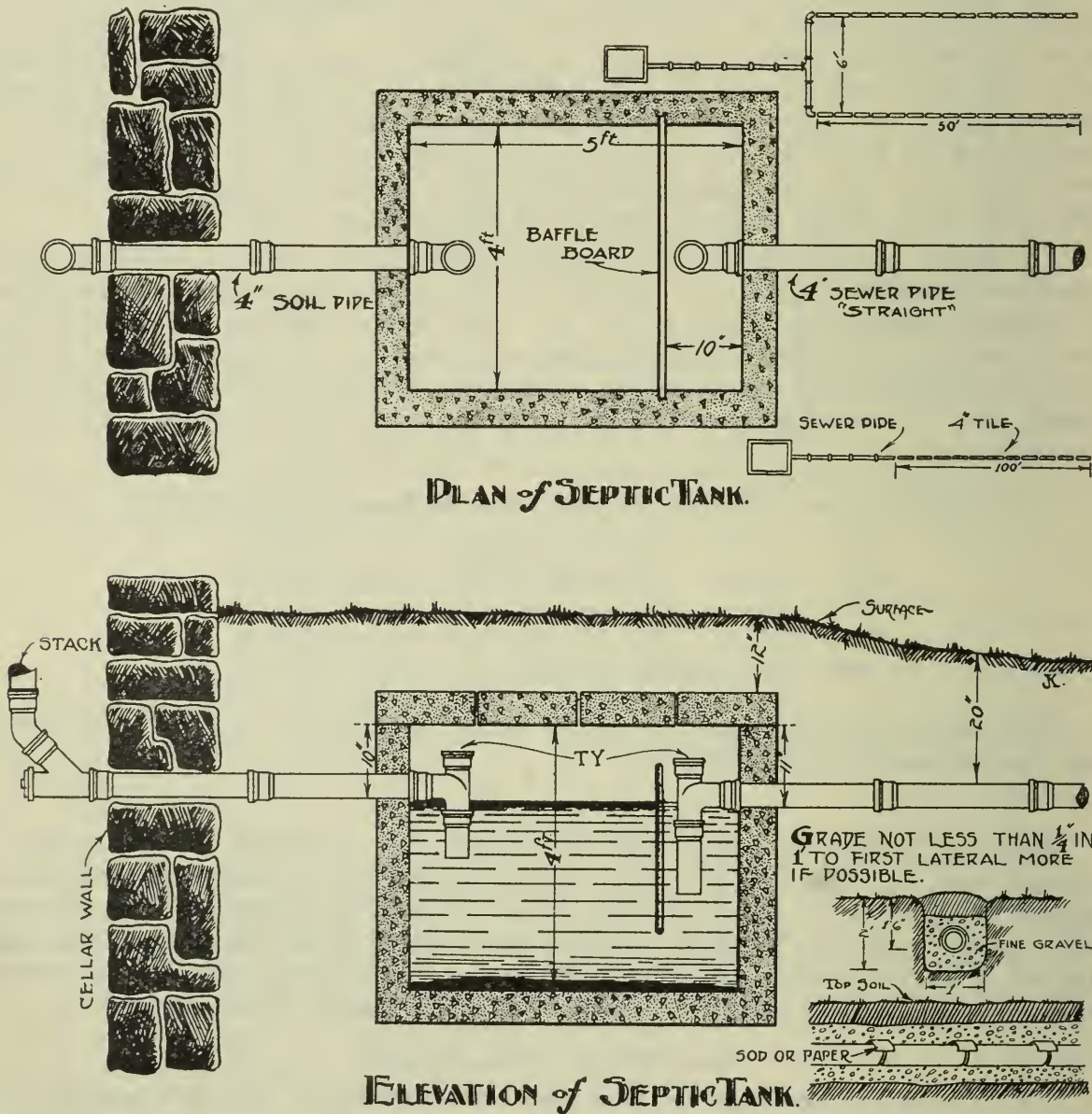


Fig. 19.—A Single-chamber Concrete Septic Tank.

SEPTIC TANK EXTENSION SERVICE

The Department of Agricultural Engineering has designed a septic tank of this type for farm service, also built portable wooden forms or molds for building the tank and supplied the same to several of the Agricultural Representatives to lend free of charge to farmers wanting to build this tank. It has also prepared a special circular describing and illustrating the tank, and how to use the form. Each applicant for the form is supplied with this circular. The form can be transported in a motor car. *If interested, telephone your Agricultural Representative or write the Department of Agricultural Engineering, Ontario Agricultural College, Guelph, Ont.*

The advantages of this tank for farmers over the two-chamber one are that it is much simpler to construct and especially so when the ready-to-use form is available; and it is considerably cheaper. It has also good capacity, enough for 4 to 6 people, and if some care is taken to lay the tile in plenty of fine gravel or some porous material (See Fig. 19) the distribution of the overflow will be satisfactory. It is not claimed that the distribution is as good as in the siphon system for medium and large septic tanks where the effluent has to be distributed through a large quantity of tile. This tank may easily be made larger if necessary by increasing the length 2 feet for every 3 or 4 people extra.

HOW TO AVOID TROUBLES WITH SEPTIC TANKS

1. *In Construction: follow instructions and plans very carefully.* We have frequently found on inspecting septic tanks that they were not built right, and trouble resulted sooner or later.

2. *Do not empty the laundry waste water into the septic tank.* Strong alkalis hinder the activity of the sewage bacteria and even destroy them in some cases. Dispose of this waste in a small cesspool as shown in Fig. 20.

3. *Build tank large enough.* It is safer to err on the side of building too large than too small a tank. Overloading a tank will cause a clogged system throughout in a very short time. The tank should be large enough to hold 2 to 3 days' discharge from house.

4. *Proper design of tank fittings.* The inlet and overflow fittings should be designed and installed as shown in Fig. 19 and it is very important that the inlet fitting shall discharge below the surface, otherwise the contents of the tank are agitated so badly that proper bacterial action cannot take place, and an overflow heavy with undigested material goes out into the tile system, and soon clogs it.

5. *Avoid placing field tile too close together at the joints.* At least one-eighth inch is necessary. The joints need covering with strips of paper to keep out the earth when filling the trenches.

6. *Lay tile in gravel.* In medium and heavy soils this is necessary, and the method is illustrated in Fig. 19. In these soils underdrainage may be a help, and the trenches should be at least 18 inches wide.

7. *Lay tile at shallow depth*—not more than 18 to 24 inches, depending upon whether soil be heavy, medium or light.

8. *Use toilet disinfectants sparingly.* These chemicals are very injurious to sewage bacteria, and bad results are sure to follow too lavish use of them. Follow directions on container, and flush out fixtures well with water when discharging the disinfectants.

9. In many cases the lines of tile are laid on too heavy a grade with the result that the lower ends of the rows receive too much liquid, while the upper ends receive very little or none at all. In porous soils the grade should not exceed 3 or 4 inches in a run of 50 or 60 feet, in heavy soils 2 or 3 inches is enough.

10. The sludge or dark deposit on the floor of the tank should be removed every 5 years at the least. This may be pumped out by a suitable pump forced down through the scum. Seldom is it necessary or desirable to remove the scum itself.

11. If a siphon be used it should be checked over every year to make sure that it is working all right.

GREASE TRAPS FOR KITCHEN AND LAUNDRY WASTE WATER

In farm kitchens there are large quantities of waste water to be disposed of daily in some way or another. It is a very unsanitary practice to throw these wastes out the back door. In homes equipped with septic tank or cesspool these wastes may be discharged into them, although there is some objection to this practice, in the case of the laundry waste water for the reason that it contains much strong alkali material which is injurious to the sewage bacteria both in the tanks and in the soil. For homes with or without septic tanks these forms of waste may be disposed of in a convenient and sanitary manner in a grease trap

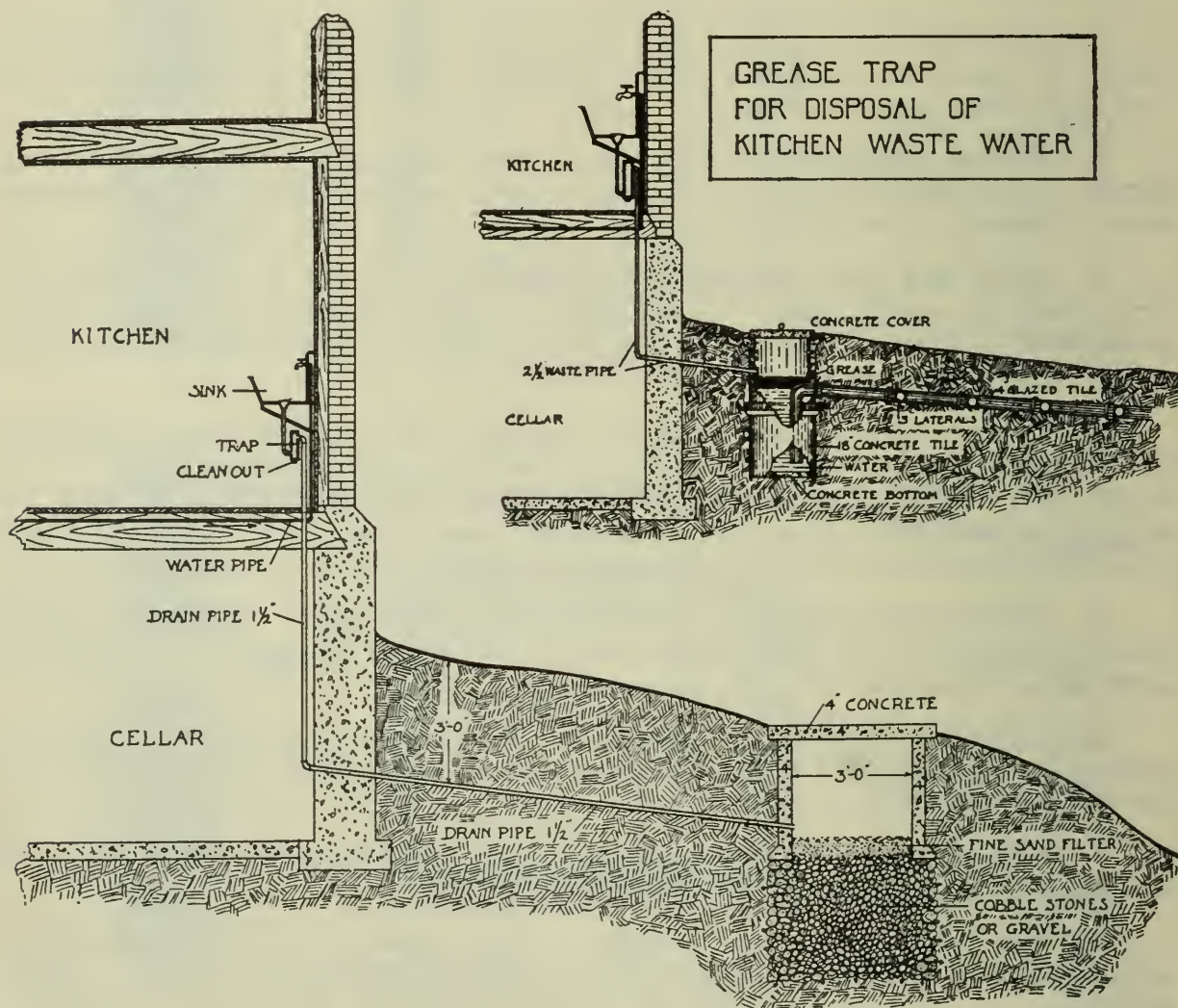


Fig. 20.—Two types of grease trap for disposal of kitchen waste water.

or miniature cesspool, two types of which are illustrated in Fig 20. The upper type is best adapted to heavy soils, and it will be necessary in this case to install a small absorption bed of about 50 four-inch drain tile in the same manner as for a septic tank. The trap should be located 10 or 15 feet away from the cellar wall and the tile ten or more feet farther away. The lower type is adapted to light, gravelly soil or any soil with a very porous subsoil well drained. The top of the trap in either case should be strong, tight fitting and removable in order that it may be readily accessible at any time for cleaning out the accumulation of grease and sediment whenever necessary. Neither one of these types is difficult or expensive to construct and their installation at any farm home not having sewage disposal system would aid materially in making conditions tidy and sanitary about the back door. Occasionally some chloride of lime or other good disinfectant should be washed down the kitchen sink or laundry drain to purify the trap.

THE CESSPOOL

Before the advent of the septic tank the cesspool was the only method of sewage disposal for farm homes equipped with plumbing fixtures. In its original and simplest form it was a hole in the ground eight to ten feet deep and four to six feet in diameter, lined up with field stone and safely covered with timbers, plank and earth. Into this pit the sewage was discharged through the inlet pipe and partly decomposed, and in the liquid form slowly seeped away in the surrounding soil. As it was a frequent occurrence for this form of cesspool to overflow, the idea was conceived of improving it by building an enclosed trough around the edge of the pit near the top of the ground and connecting it to rows of field tile, radiating out like the spokes of a wheel, and the liquid was conveyed from the pit to this trough by a three or four-inch pipe between them and turning down a foot or so into the contents of the pit. This is some improvement upon the older form, but not much unless the pit itself is made water-tight to prevent seepage into the soil below.

OBJECTION TO THE CESSPOOL

One serious objection to the cesspool has already been referred to, namely, its overflowing. This condition may be due to a very heavy and poorly drained subsoil, or too small a pit, or both. The installation of tile already referred to will prevent this trouble for a while, but they soon fill up by the constant dribbling into them of liquid and fine solids. Another bad feature is that the well may be contaminated by the underground seepage from it, and as this seepage may be carried great distances through small channels and the various forms of passages through the soil and rocks below the surface there is always a lurking danger not only to the water supplies near-by but even to those more remote. If the subsoil be very gravelly and well drained and one could be absolutely certain that there was no chance of the seepage endangering the water supply or reappearing somewhere at the surface as a public nuisance, there could be no serious objection taken to the building of a cesspool, but as the possibilities of trouble with it are so great we cannot recommend it to the general public as a safe and satisfactory method of sewage disposal.

A WARNING

Absolutely avoid emptying house sewage and wastes of all kinds into old abandoned wells, or into farm or roadside drainage systems.

CHEMICAL CLOSETS.

Where there is no running water in the house, and an inside toilet is desired, the chemical closet or the modified water system of sewage disposal in some form must be used. The two common types are illustrated in Fig. 21 (a) and (b). Briefly, the chemical closet consists of a receptacle of metal or wood to hold the sewage and a chemical added from time to time to destroy it. The small type shown in Fig. 21 (b) is commonly called the commode and is adaptable for setting up in any convenient place in the home where a vent pipe to the outside can be installed. It needs frequent emptying and charging with chemicals, say about once a week, if satisfactory results are to be realized. This kind is quite cheap, about \$10 to \$15, the price depending upon the size and design.

The design shown in Fig. 21 (a) is more elaborate and costly, but it is fairly efficient. It is made in a great range of sizes, from that suitable for a private

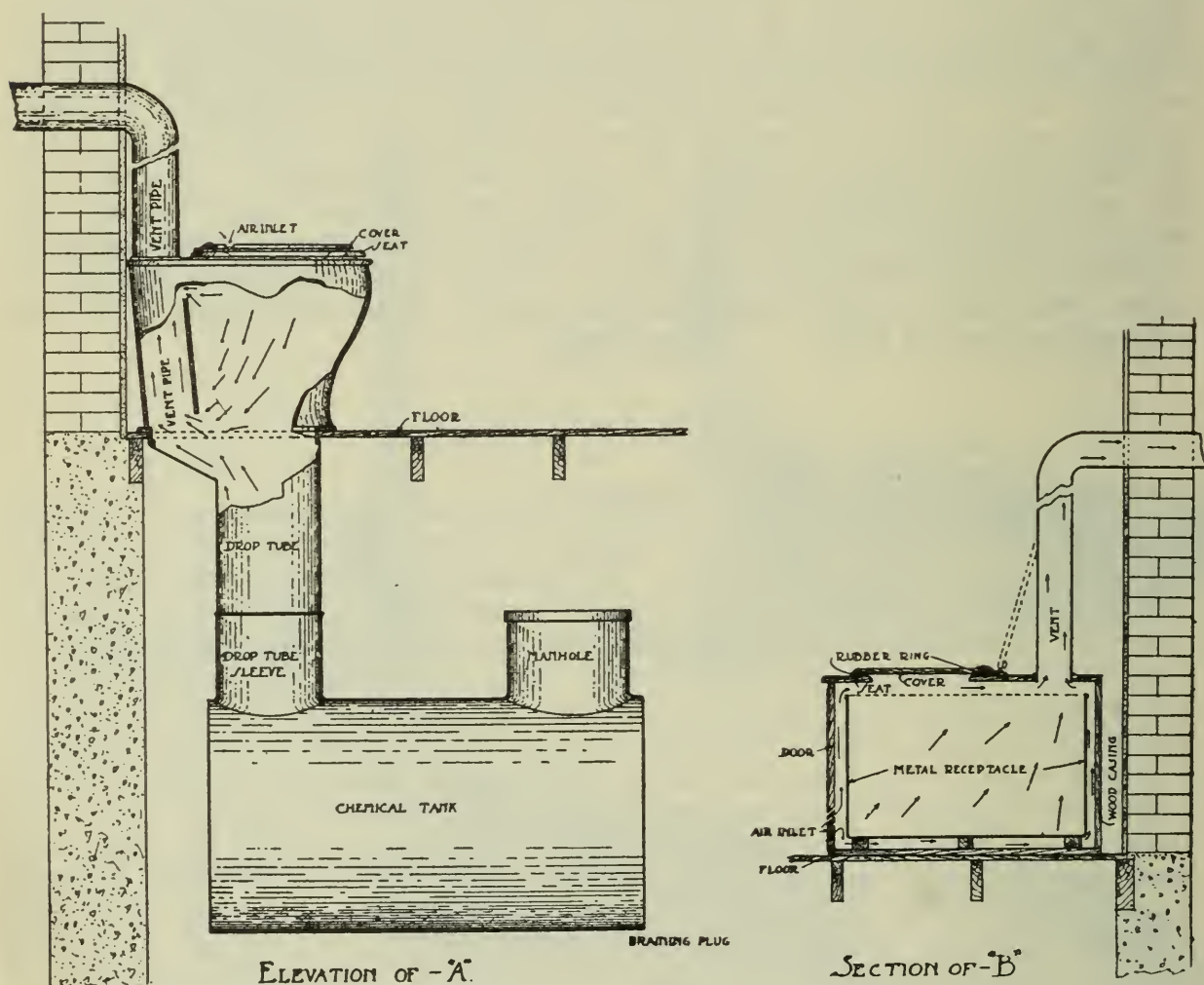


Fig. 21—Two types of chemical closets.

home to large institutions like schools, hospitals, camps, etc. It consists of a metal tank, a nicely designed closet bowl, drop tube and ventilating pipe, and usually an agitator in the tank for mixing up the sewage and chemical. For a house of average size, the tank has a capacity of 125 gallons, and the cost of the complete outfit is in the neighbourhood of \$100. This type does not need much attention, the regular thirty-pound charge of chemical being sufficient to sterilize 125 gallons of sewage. Every 6 months the sludge should be removed from the tank either by pumping out through the top manhole or draining into a cesspool from the bottom.

The Department of Agricultural Engineering will be glad to supply further information regarding chemical closets, particularly in regard to different makes, names of firms selling them, etc.

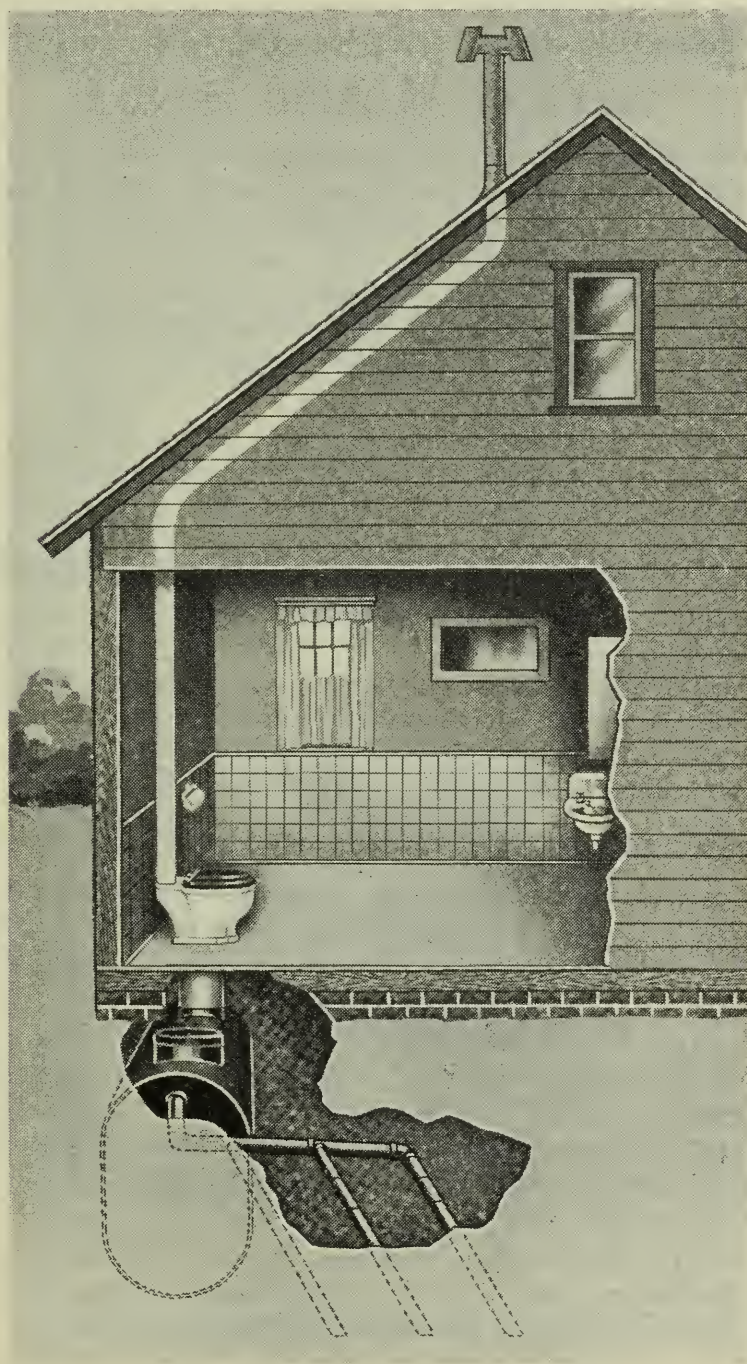


Fig. 22.—Installation of Modified Water System of Sewage Disposal.

THE MODIFIED WATER SYSTEM OF SEWAGE DISPOSAL

(See Fig. 22)

In design this system is similar to the standard types of chemical toilets, as illustrated in Fig. 21, but the digestion of the sewage is effected by bacterial action as in the septic tank, and not by chemicals as in the chemical toilets.

After installation is completed the large tank is about two-thirds filled with water, and subsequently a pail or so of water per day is added. The overflow is taken care of by a tile system. The sludge in the tank should be removed every 3 to 5 years.

USES OF THESE SYSTEMS

Both systems just described are well adapted to farm and village homes, summer cottages, rural schools, community halls, tourists homes and camps, or any case where running water is not available. When they are properly installed, well ventilated and given the necessary care, they are fairly efficient, and well worth while from the standpoints of *convenience* and a *protection to the water supply* on the premises as compared with dry earth toilets outside the house.

TYPES OF OUTSIDE PRIVIES

The two most satisfactory types of outside privies are illustrated in Figs. 23 and 24. The chief difference between them is in the kind of receptacle used; in the former it is a pail or box, while the latter an underground water-tight vault. These designs are recommended by the Provincial Board of Health, Parliament Buildings, Toronto, and a full treatment of the subject is given in their circular No. 9, entitled "Rural and Semi-Urban Sanitation," which may be had on application to them. As the accompanying figures give all the details and measurements no further description is necessary.

In order to make these privies as sanitary as possible they should be built fly-proof and screens put in the door and on two opposite sides, as shown in the drawings, for purpose of ventilation. The receptacles should be cleaned out often and they should be disinfected each time with chloride of lime, and dry earth may be used regularly on the contents of the receptacle or vault with good results. If the privy is built and attended to as herein specified it may be located quite close to the house, preferably inside or attached to the woodshed to avoid undue weather exposure to those using it. The purposes of the waterproof underground vault are threefold; to prevent the seepage of contamination underground to the well, to increase the storage capacity for sewage and make less frequent cleaning possible, and, lastly, to keep out flies.

SEWAGE DISPOSAL IN RELATION TO PUBLIC WATER SUPPLY

Those who intend to install sewage systems should bear in mind carefully the fact that our water supplies are protected by law against sewage contamination. The articles in the Public Health Act that pertain to this case are given herewith as follows:

"Article 90—The Provincial Board shall have the general supervision of all springs, wells, ponds, lakes, streams or rivers used as a source for a public water supply with reference to their purity together with the waters feeding the same, and shall examine the same from time to time when the necessity for such examination arises, and inquire what, if any, pollution exists and the causes thereof. 2 Geo. V, c. 58, s. 90.

"Article 91—(1) No garbage, excreta, manure, vegetable or animal matter or filth shall be discharged into or be deposited in any of the lakes, rivers, streams or other waters in Ontario or on the shores or banks thereof."

Therefore it is the duty of all parties putting in any form of sewage disposal systems to strictly guard against any possibility of them directly or indirectly contaminating the sources of public water supply.

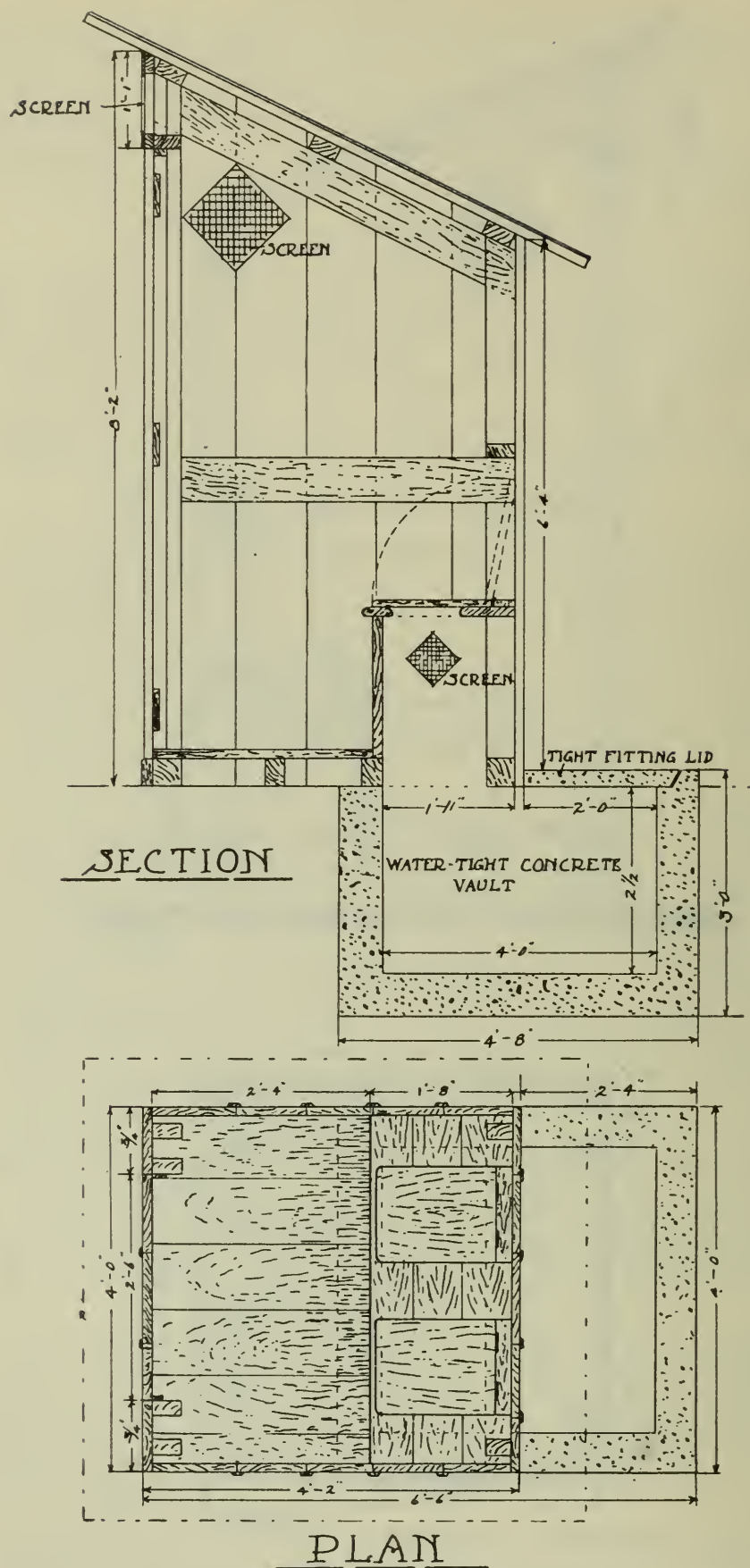


Fig. 24.—Section and plan of outside privy.

THE SEPTIC TANK METHOD OF DISPOSING OF CHEESE FACTORY
AND CREAMERY WASTE WATER

By FRANK HERNS, CHIEF DAIRY INSTRUCTOR, LONDON, ONTARIO

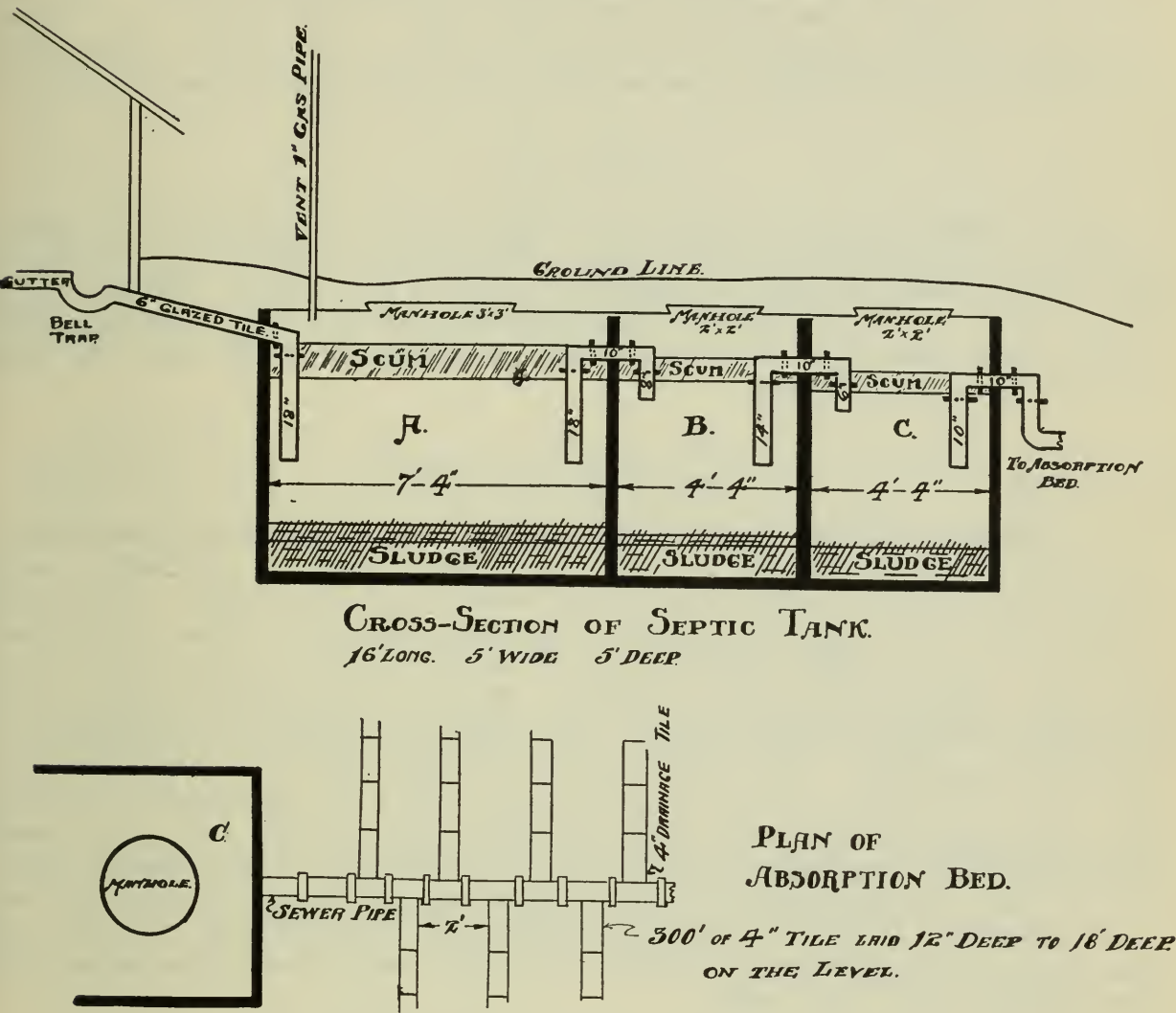


Fig. 25.—System of taking care of Cheese Factory and Creamery Waste.

Special Note Regarding Absorption Bed:

Either 4-inch or 6-inch tile and a quantity varying from 300 to 500 feet are required, varying with the size of the system. The length of the branches should not exceed 50 or 60 feet.

The disposal of cheese factory and creamery wash water by the septic tank system presents, because of the special kind of solid content, greater difficulties than does the handling of house sewage. The fatty solids especially (which do not readily decompose) must be prevented from entering and clogging the tile.

The tank should have at least three compartments through which the waste water must pass on the way to final absorption by the soil. With hard soil, a filter bed is necessary which may require special drainage, since an outlet for the surplus water not absorbed by the soil or taken up through evaporation must be provided.

The cement tank is so constructed as to retain most of the sediment and floating material in the first compartment. The additional chambers retain most of the organic matter and sediment which may pass over from the first section and thus prevent so far as possible anything but water from leaving the last

compartment. Decomposition of the organic matter is encouraged through retention in the tank for as long a time as possible.

In the settling chambers, any material which will float rises to the top in the form of scum, while sand and some other sediment falls to the bottom. The tank must, therefore, be cleaned about once each season. The organic solids slowly decompose through bacterial action and since most of this material remains in the first section of the tank, it must be large enough to provide for an accumulation.

SIZE OF TANK

The larger the tank the longer the sewage may be retained and the greater will be the decomposition of the organic matter before the liquid passes into the tile. There should be capacity sufficient to hold all of one day's washings in the small section C. A double partition cement tank, 16 feet long, 5 feet deep and 6 feet wide with 5-inch walls and 4-inch partitions, should be about the right size for the average factory.

CONSTRUCTION OF TANK

Six-inch glazed tile, carefully laid, may be used to conduct the waste water from the factory to the tank. A bell trap is placed either in the factory gutter or near the factory to shut off the odour coming from the drain. At the point at which the water enters the tank it is desirable to attach an elbow with an arm (about 18 inches long), the lower end of which is always in the water below the scum. This prevents the breaking of the scum and undue mixing of the incoming sewage with that already in the tank — a matter of importance in successful operation. The tank should be covered with six or eight inches of soil and kept air-tight except where the vent (which may consist of a two-inch gas pipe properly stayed and extending beyond the top of the factory) is placed to carry off the foul gases caused by the decomposition of the material within. An air inlet may be required at the discharge end of the tank to make the vent more effective. In order to afford communication of sections A, B and C with the vent, the two partitions should have at least one inch of space between the top and the cover of the tank.

For cleaning purposes a man-hole is left in the cover of each section, or the cover is so arranged that the different sections may be gotten at easily, especially the first and largest compartment.

The discharge pipes are placed at opposite ends of the partitions in the tank and may consist of special four-inch sewer fittings or be made of four-inch iron pipe with four-inch elbows.

The tank plan indicates the length of the discharge pipes required for withdrawing the water from section A and discharging into section B; from section B into section C and from section C into the tiles or drain. The discharge pipes in the partition between section B and C are placed four inches lower than those in the partition between section A and B, and similarly the discharge pipes from section C into the tile are placed four inches lower than those in the partition between section B and C.

For creameries it is well to lay one-and-a-half inch gas pipe over the tank through which the pure water from the cream cooler and cream vats may be discharged directly into the drain. This water requires no purification and if conducted through the tank would necessitate one of too large dimensions and

the large amount of cold water running into the tank might cool the contents too much for a rapid decomposition of the solids.

THE RECEIVING TILE AND ABSORPTION BED

Four-inch tiles are laid level under twelve to eighteen inches of soil in rows two feet apart to receive the treated sewage from the tank and thus distribute it evenly over the ground area. The joints are left slightly apart and may be covered with pieces of tile or tar paper to prevent soil from falling into the joints. It will require about 300 tile to dispose of the water, although the number will depend on the amount of water that has to be disposed of and the condition of the ground. Sandy or gravelly soil will readily absorb water. Four-inch field tile will hold approximately one-half gallon each. Therefore 300 tile will be sufficient for about 150 gallons of water.

If the soil is stiff clay or not porous it will not readily absorb the water, in which case it will be necessary to construct a filter bed of sand and gravel to the depth of twelve to eighteen inches through which the tile is laid. An outlet through underdrainage of the filter bed for the surplus water will be necessary.

A FEW POINTS TO BE REMEMBERED

- (a) Tank of sufficient capacity. For large factories increase the size of tank and absorption bed twenty-five per cent.
- (b) At least three compartments.
- (c) Prevention of fatty solids from leaving the tank and entering the tile.
- (d) Sufficient tile, properly laid to dispose of the water.
- (e) Under-drainage of clay soil and filter bed constructed.

BULLETIN 400

MARCH, 1939

Ontario Department of Agriculture

TORONTO, ONTARIO

TURKEY PRODUCTION

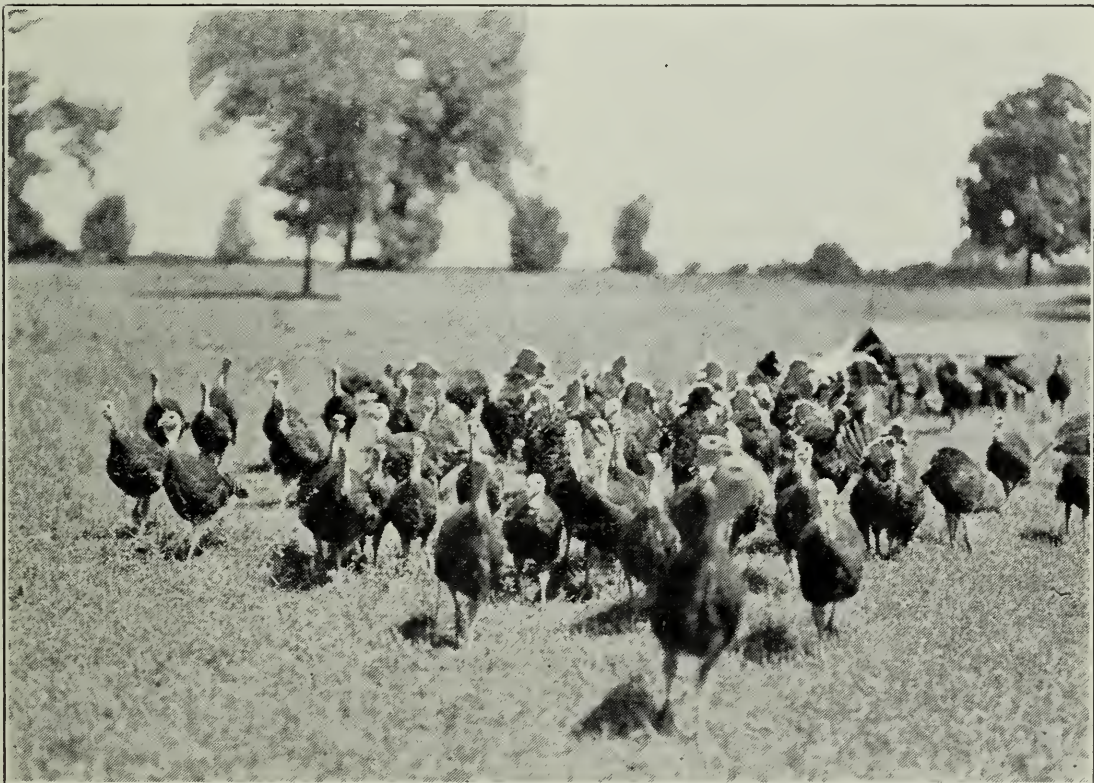
By

F. N. MARCELLUS

Professor of Poultry Husbandry

ONTARIO AGRICULTURAL COLLEGE

GUELPH - ONTARIO



TURKEY PRODUCTION

By F. N. Marcellus, B.S.A., B.V.Sc., V.S.

Turkeys are kept primarily for the production of meat. Some breeders are especially concerned with the breeding of high class show stock but they do not represent any large proportion of those engaged in turkey production. However, many of these breeders in recent years have made a real contribution to the improvement in type and quality and the economic value of our several breeds.

Of the turkeys listed in the American Standard of Perfection four breeds are moderately popular in Ontario. The Mammoth Bronze, the largest breed, is outstanding in numbers and represents probably sixty-five per cent of the turkeys in the Province. Next to the Bronze, in order of preference, are the White Holland, Bourbon Red and the Narragansette.

The general market demand is for an eighteen pound tom and a twelve pound hen. This varies over a two or three year period, influenced no doubt by economic conditions. It is well to remember in this matter of weights of the sexes that a twelve pound hen will mean about a twenty pound tom in breeding and rearing practice.

The Bronze is somewhat easier to pluck than the White Holland or Bourbon Red; the White Holland has a greater tendency to a bluish finish when dressed; the Red is often used for crossing purposes and produces a blend in color.



Fig. No. 1. A group of several hundred turkeys consisting of Mammoth Bronze, White Holland, Bourbon Red and Narragansette.

The standard weights of these breeds are as follows:

	Adult Tom	Yearling Tom	Young Tom	Adult Hen	Yearling Hen	Young Hen
Bronze	36	33	25	20	18	16
White Holland	33	30	23	18	16	14
Bourbon Red	33	30	23	18		14
Narragansette	33	30	23	18		14

In no case is it wise to attempt to keep turkeys and chickens in close cohabitation. It is a well established fact that chickens three months of age or older, while not usually showing mortality from Blackhead (entero-hepatitis) infection, may act as intermediate hosts of the infection and thus keep the disease in an active state. Turkeys in the same pens and yards are almost certain to develop the disease.

THE BREEDING PROGRAMME

The Breeders should be selected from the flock in late Summer or early Fall, before marketing begins. This will permit of making the best possible selection.. It is advisable to select two or three times as many birds as one intends to breed from and then, as they develop, cull out those that do not show suitable type and quality. Birds selected for breeders should be vigorous; free from evidence of infection; broad, full breasted and well fleshed to the rear point of the keel, and with the least possible prominence of the front end of the keel bone. They should be good representatives of the breed, but meat is the major factor and it is the plump, smooth carcass that is in demand.

It is good practice to make up the breeding pens early, especially if bringing in breeders from outside sources. One male will be sufficient for ten to fifteen females. In turkey breeding one service of the male is sufficient to fertilize an entire clutch of fifteen to thirty eggs.

One, two or three year old females may be used but as a rule the older the bird the fewer eggs she will lay in the season and the poorer they will hatch. Extremely large or very fat hens are usually shy breeders.

HOUSING AND FEEDING OF BREEDERS

Turkeys, being quite hardy, do not require anything elaborate in housing accommodation. An open shed or barn which will provide dry shelter, with roosts well up from the floor or ground, will prove adequate.

Feeding the breeders during the Winter months is a simple matter as a maintenance diet only is required. This may consist chiefly of whole grain, preferably mixed wheat two parts, oats one part, and cracked corn one part. Heavy feeding that would result in an over-fat condition should be avoided. Hard, insoluble grit should always be available, also oyster shell.

At least four weeks before eggs are desired for hatching, mash feeding is started. This may consist of a special turkey breeder mash, a chicken breeder mash to which is added four percent additional animal protein, or a regular laying mash which contains at least ten percent of buttermilk powder, plus six percent of other animal protein and at least one percent of a good grade of cod liver oil or other suitable fish oil. Grain feeding is of course continued with the mash. For green feed supply for breeding stock one-half the breeding yard may be sown with Fall rye in the Fall and the other half seeded with the same grain in the Spring.

NESTS AND BREEDING PENS OR YARDS

An ample supply of nests is advisable, one to each two or three birds. These may be made of apple or sugar barrels placed on their side, or boxes twenty inches square and not over ten inches in depth. Nests are best located in secluded locations and on the ground if possible.

If only one breeding group is kept special yards will not be necessary, except for keeping the birds within bounds for nesting and laying. However, if one is breeding several males in separate breeding groups it will be advisable to isolate the groups; otherwise, if they are in sight of one another they will worry to the extent that fertility may be seriously affected.

EGG PRODUCTION AND INCUBATION

When egg production begins early in March the eggs should be collected regularly and frequently to prevent chilling. This may be facilitated by the fact that most of the birds will lay during the forenoon. The eggs when collected are best held in a room in which the temperature is fairly constant and around fifty-five to sixty degrees. While being held they are placed small end down. Eggs may be satisfactorily kept for seven to ten days before setting but they will produce better hatches and better poults the sooner they are set after they are laid.

The eggs may be incubated under turkey hens but most people prefer to break up the brooding attempt and get the bird laying a second and even a third clutch of eggs. Natural incubation is similar in practice to that followed in chickens. One point which possibly should be emphasized, however, is the need for vermin control on the setting hen. She should be thoroughly dusted with good insect powder such as sodium flouride. It is wise to make two, or better three, applications, one when she is first set, one at ten or twelve days and the third at twenty to twenty-three days. Make the application of powder fairly general on all parts of the plumage and work it well into the feathers.

Turkey eggs may be satisfactorily incubated in the same machines used for hatching hen eggs. It is better, however, to hatch turkeys in separate incubators than those in which the chicks are being hatched.

ARTIFICIAL BROODING

Colony house brooding pens, similar to Fig. No. 2, will probably prove the most satisfactory. A house 8' x 10' will house one hundred and fifty to one hundred and seventy-five poults. Larger houses, 16' x 16', housing three hundred to four hundred poults, have been used but are much more difficult to move.



Fig. No. 2. Colony house, 16' x 16', of a type used extensively for brooding.

The house should be placed on a high, dry, well drained location. If a patch of Fall rye or short grass is available on a suitable location this would be an excellent place to locate the house. Such conditions would provide tender green feed and the poults would not get chilled in the long, wet grass.

The litter used on the floor may be anything the young poults will not eat. Perhaps for the first week or ten days covering the floor with old newspapers would be best as they may be removed and burned as they get dirty. Clean sand is excellent, especially after the poults have learned to eat, or after the first week of brooding. Avoid any material which may be musty or one of a stringy or thready nature.

The house, if previously used, should be thoroughly cleaned and disinfected. Set up the brooder stove and start it operating two days before the turkeys are to be put in, or long enough in advance to have the house thoroughly dry and to make sure the stove is regulated and working satisfactorily. A temperature of about ninety-five degrees two inches from the floor level, depending on the season, will do to start with. This may be reduced, after the first week, at the rate of five degrees per week.

It is wise to place a circle of fine mesh wire netting around the stove, about eighteen inches away from the outer edge of the hover. After the first couple of days enlarge the circle from day to day until it is expanded to the walls except at the corners. This will help prevent the young poults piling up. It also prevents them getting too far away from the source of heat until they have learned where to get warm.

Some follow the practice of installing low roosts in order to get the birds started roosting early. An arrangement of this kind is shown in Fig. No. 3, but for a start the roosts would be better if placed nearer the floor.

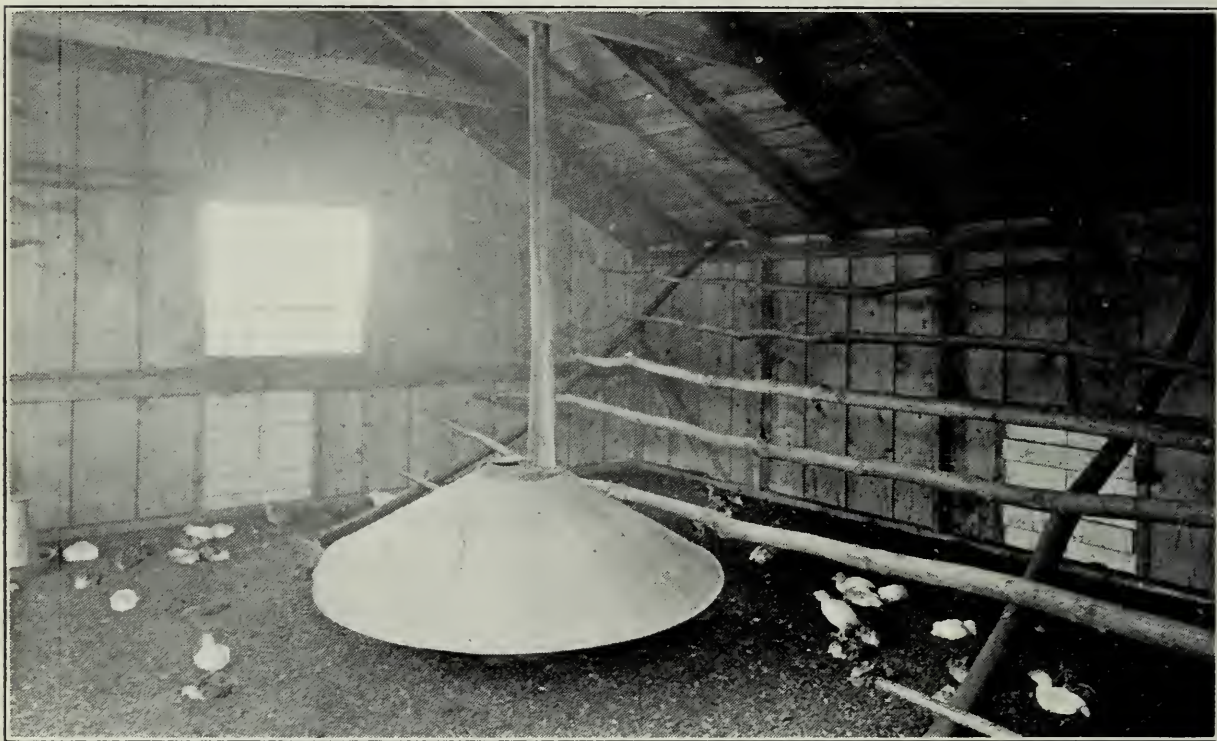


Fig. No. 3. Inside view of colony brooding pen showing coal burning brooder stove and roost arrangement.

Provide small, outside yards. In nice weather allow the poults out in the yards when four or five days old. The yards may be enlarged as the poults get older but keep them confined in the yards until three or four weeks old.

NATURAL BROODING

The young poults must be kept under control. This may be done by placing them in a small pen, say 8' x 10', made of twelve inch boards placed on edge. Move the pen each day. Keep the poults thus confined until they can fly over the boards. Watch for lice on the poults at from two to six weeks

of age. If present they will likely be found on the first quills or feather shoots. The hen should be confined every night until the poults are six weeks old but may be allowed to range in the day time when the grass is dry.

The coops and yards are best located on dry, high, well drained land. Grass land where the grass is short would be ideal.

FEEDS, AND THE FEEDING OF YOUNG TURKEYS

The following ration, fed as a dry mash, has proven satisfactory for young poults whether raised in brooders or under hens.

585	lbs.	corn chop (No. 2 yellow, or corn meal)
350	"	wheat chop
200	"	oat groats (hulless oats or oat middlings)
285	"	buttermilk powder
300	"	meat meal
100	"	fish meal
50	"	bone meal
50	"	fine oyster shell
50	"	fine grit (insoluble)
15	"	iodized salt
15	"	cod liver oil.

If skim milk or buttermilk is available the buttermilk powder could be left out of the above mixture and the liquid milk given as drink. In late season brooding the cod liver oil may be left out of the above feed mixture as the poults will be out in direct sunshine.

When the poults are thirty-six to forty-eight hours old they are fed the above mash in hoppers. There is little danger of them over-feeding. Under-feeding is to be avoided as it might result in serious loss. If difficulty is experienced in getting the young poults to eat, sprinkling finely chopped green feed over the dry mash in the hoppers may help to start them. Young poults are somewhat picky about their feeding but in any case they do not eat much the first few days.

Green Feed: A liberal supply of green feed is absolutely essential in the ration of turkeys. After the first few days it will constitute one-third to one-half of their total ration. The green stuff used, especially for the first three or four weeks, should be tender and free from thready fibre. Lettuce leaves, Fall rye, finely chopped onion tops, dandelion leaves or lamb's quarter

(*chenipodium alba*) are excellent for the purpose. Fall rye sown in the Spring grows rapidly and makes excellent early pasture, Fig. No. 4, or may be cut with a lawn mower with catcher attachment and cut fine for mixing with the mash. The rye may be sown one and one-half to two bushels per acre. One-



Fig. No. 4. Poults one week old, feeding on young rye growth.

quarter of an acre will be sufficient for three hundred to four hundred birds and may be pastured three weeks after seeding. Where poults are confined to the colony house give them all the chopped green feed they will eat three or four times a day.

When brooding naturally give the turkey hen some mixed grain twice a day.

NEVER PLACE FEED FOR TURKEYS ON THE GROUND. IT SHOULD ALWAYS BE PLACED ON BOARDS, IN TROUGHS OR HOPPERS. MOVE THESE DAILY. KEEP DRINKING FOUNTAINS CLEAN.

WHEN TO DISCONTINUE HEAT

Young turkeys, six to seven weeks of age, are fairly well feathered and can stand some wet and chill. However, it may be wise to keep the brooder stove fire going for a week or two longer, especially early in the season. The hover may be removed but a little extra heat at this time may prevent a bad case of crowding if the temperature should drop suddenly at night.

FEEDING AFTER SIX WEEKS OF AGE

The suggested 'starter' ration is continued after six weeks. The oat groats may, however, be replaced with oat chop. A moist mash is fed at this time, preferably at noon. Simply moisten some of the mash already in use, with milk or water. The moist mash may help to keep the birds feeding in the hot weather when, otherwise, they might not eat the dry mash freely. Keep up the supply of green feed, either in the chopped form or good Fall rye pasture. At six to seven weeks of age give a little grain—cracked corn one part, wheat two parts and oats one part. If the birds do not eat the grain readily at the start a little may be mixed with the moist mash—one of grain to ten of mash—or the grain may be placed in the bottom of the trough and the moist mash spread over it. Just as soon as the birds begin to eat the whole grain readily feed it in separate hoppers. This would provide both dry mash and grain before the birds all the time and a daily noon feed of moist mash.

Do not try to limit the feed supply; allow the birds to eat all they wish. The more feed they consume the faster they grow. Be careful to keep the animal protein level in the diet relatively high, at least 20 percent. This will insure a plumper, fuller breasted bird with that rich creamy-like finish; while a skimmed, poor diet means thin, blue-fleshed birds that cannot even be given away.

In hot weather it may be wise to reduce somewhat the amount of moist mash fed as the birds will not eat freely in real warm weather. The amount of moist mash fed should be regulated to what the birds will clean up readily.

Feed all moist mash in troughs 10" to 12" deep. Keep these troughs absolutely clean by frequent cleaning. Move troughs, hoppers and fountains daily. It will help prevent the introduction and spread of Blackhead and other intertinal infections.

MANAGEMENT ON THE RANGE

At seven or eight weeks of age the birds will show a desire to roost out of doors. They are then better roosting outside from this time onwards. Roosts similar to those shown in Fig. No. 5 will serve nicely.

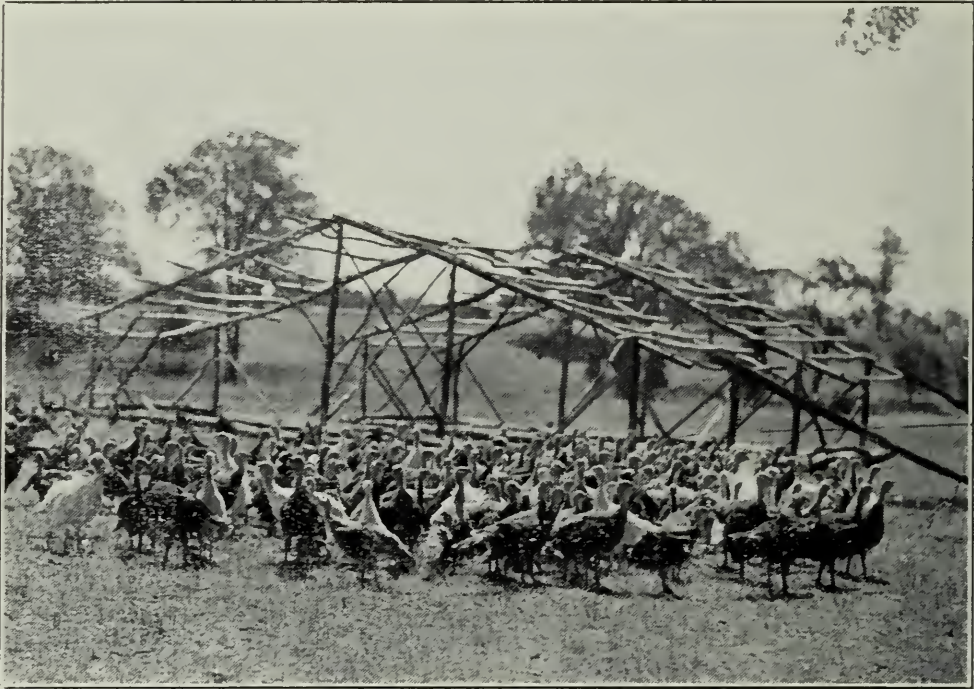


Fig No. 5. Outdoor roosts built of poles and on skids so they may be easily moved with a horse or team.

The feed hoppers, feed troughs and drinking fountains may be lined up across the range, as shown in Fig. No. 6. They are moved forward a few feet daily, thus getting away from any spilled feed, and the equipment is on clean ground.



Fig. No. 6. Range scene showing feed troughs, hoppers and drinking fountains arranged in a row for regular, systematic moving.

Give special attention to an adequate and continuous green feed supply on the range. Fall rye may be sown until the 1st of June, giving pasture until after the 1st of July. This might be supplemented with some oats, sown about the middle of May, for pasture when three to five inches high and the turkeys four to five weeks of age. Rape, sown ten pounds per acre, the end of May or early June at the rate of one acre for each thousand birds, would provide green succulence in July and August. **This is very important.** The quantity and quality of the pasture would be improved by the application of two hundred to three hundred pounds of commercial fertilizer per acre applied at the time of seeding.

In the late Summer sow some Fall rye for pasture in the Fall season. One acre to each hundred and fifty birds should be provided.

LATE SUMMER AND FALL MANAGEMENT

Move the outdoor roosts, shown in Fig. No. 5, just as often as the surrounding conditions become unsanitary. If the operator would prefer not to move the roosts then the droppings should be scraped up and carted away.

Be sure when constructing outdoor roosts to see that they are strong and well braced. Seventy-five to one hundred turkeys when nearing maturity represent a weight of from one-half to one ton. A sudden collapse of a roost might result in the loss of several birds.

If a group of turkeys, occupying one of these outdoor roosts, is badly frightened at night by animals or wild birds the roosts should be moved to a new location before the next night; otherwise the birds may not return to the roosts.

Turkeys will range in groups of several hundred to the group. Great care should be taken to see that there is ample feeding space at the troughs and feed hoppers. This will help prevent fights starting, due to over-crowding.

Keep turkeys and chickens on separate ranges. Better sanitation can be maintained in this way. If unleached hardwood ashes are available these may be placed where the birds have access to them but the ashes should be dampened first. The consumption of the ashes may help control intestinal parasites.

FINISHING BIRDS FOR MARKET

If birds are grown as previously recommended special feeding may not be necessary. However, in some cases some special finishing feeding is required. In such cases start the special feeding five to six weeks before the birds are to be marketed. One must be careful about making any radical changes in diet at this time as the birds often will not respond to the sudden change.

Some feeders claim best finishing results from increasing the amount of grain; others strongly advocate feeding more mash, two feeds per day. It is probable that using large amounts of each would give best results with the average feeder but increasing the milk content of the ration will improve the finish. It is well to remember, however, that turkeys will not fatten as well in warm as in cool weather. A sudden change from low to higher temperatures a week before killing time may result in the birds dropping off in feed consumption and losing weight until the weather again turns cooler.

KILLING AND DRESSING

Do not give any feed for twenty-four hours before killing. Turkeys may be killed by bleeding and braining in a manner similar to that outlined for chickens in Ontario Bulletin No. 395, "Farm Poultry." In plucking pull the feathers out; do not attempt to rub them out as is commonly done in plucking chickens. The skin bruises easily and these bruises, much more conspicuous twenty-four hours later, may take all the season's profit off the selling price of the bird.

Wash the blood out of the bird's mouth after plucking and clean the dirt off the feet. Hang the bird up by its feet, which are tied together. After the birds have cooled, wrap the heads with regulation head-wraps.

GENERAL OBSERVATIONS

Turkeys are subject, for the most part, to the same infections and parasitic infestations as are common to chickens. In this connection the reader is referred to Ontario Bulletin No. 394, "Diseases of Poultry."

Young turkeys are possibly more sensitive to feed deficiencies than chickens. There are indications that the poults' requirements for both vitamins A and D are twice that of the chick, hence green feed and cod liver oil are important in the diet.

Breeding males may require the toe-nails clipped in order to prevent tearing the backs of the females in the breeding season. The use of duck or canvas back blankets for the females may be advisable, especially where very large toms are used.

The quadruple-yard system, shown in Fig. No. 2, is favoured by some for rearing young turkeys using four, acre paddocks with a colony brooding coop in the centre. It has both advantages and disadvantages.

An abundant supply of hard, insoluble grit is necessary at all times.

Clean, fresh drinking water in clean utensils is absolutely essential at all times.

Sanitation is the foundation of successful turkey production.

BULLETIN 401

MARCH, 1939

Ontario Department of Agriculture

Statistics and Publications Branch

TORONTO, ONTARIO

Feeding and Management of Work Horses

BY

M. W. Staples, B.S.A., M.S.

DEPARTMENT OF ANIMAL HUSBANDRY
ONTARIO AGRICULTURAL COLLEGE
GUELPH, ONTARIO



"Jock"—Clydesdale gelding—first prize three-year-old and reserve for the Saskatchewan Shield, Royal Winter Fair, 1936. Bred and exhibited by the Ontario Agricultural College.

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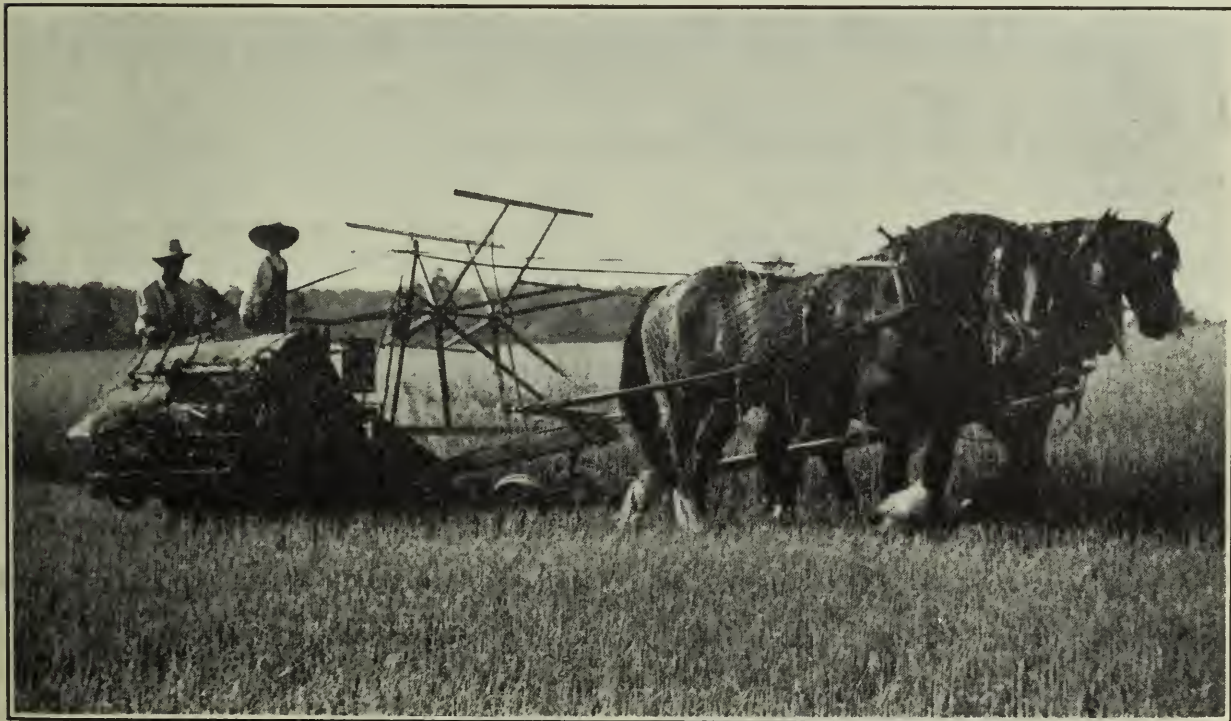
FEEDING AND MANAGEMENT OF WORK HORSES

by

M. W. STAPLES, B.S.A., M.S.

IN RECENT years the usefulness of the horse has been more and more confined to the farm. In the march of progress the motor car and motor truck have more or less displaced the horse on roads and to a less extent for haulage purposes. In fact in our cities and towns many companies have disposed of their delivery and draft horses, but the winter of 1938 and 1939 has clearly demonstrated that for haulage and delivery purposes the horse is not yet indispensable.

For farm work no arguments need be advanced. The horse fits very well into the pay-as-you-go policy of the Ontario farmer or, in other words, is economically sound. The "fuel" is produced on the farm at first cost and without a cash outlay. It is not necessary to point out that much of the feed used has little cash market value.



A typical harvest scene with farm horses of good, useful type.

“Rest and fat are the greatest enemies of the horse” according to an old Arab saying. Regular work or exercise, and careful feeding, are essential for health and a long period of usefulness. While for best service a horse should not be over-fat, at the same time he should be in good condition. Fortunately, we produce excellent horse feeds and have a suitable climate for the work horse.

GENERAL CONSIDERATIONS IN FEEDING

Water. This is one of the most essential things in the ration of horses and yet its functions are often overlooked. Water aids in digestion, carries off waste products from the body, and cools the animal. Water before feeding; if the reverse is necessary allow at least one hour to elapse before watering.

When horses are being worked they should be given a drink after the evening meal.

A horse usually raises his head at least once during his drink; he should not, therefore, be taken from the trough when he first ceases to drink. About five minutes should be allowed.

An over-heated horse should not be allowed to drink his “fill”.

Use a variety of feeds. In order to fill all the requirements of a ration—nutrients of the proper amount and proportions, bulk enough for safety in digestion, and a high degree of palatability—it is important that a variety of feeds be fed.

Variety is quite all right but avoid all sudden changes. A quick change from old to new oats or from no oats at all to new oats may result in digestive disturbances, such as colic. By “new” oats are meant oats threshed out of the stook in August or September. A quick change from old to new hay or from stable to pasture should likewise be avoided.

Wilted grass is much more dangerous to feed than fresh grass.

A horse will choke more readily on being fed grain immediately on coming in from pasture.

Mouldy and dusty feeds must be avoided. Mouldy feeds will frequently cause poisoning when fed to horses. Dusty feeds may cause heaves.

Feed according to the work. The amount of feed given should vary with the work performed. The character and amount of the ration should be modified to meet each change of work.

Salt is essential for the horse. The amount given varies with horses, usually from one to two ounces daily.

Minerals or mineral mixtures are usually not necessary for horses. If such is required, a mixture of equal parts by weight of salt and bone char is satisfactory. Feed as you would salt.

FEEDS

Feeds for horses may be divided into concentrates, roughages and succulent feeds.

CONCENTRATES

Oats are an excellent feed for horses and are the standard with which other concentrates are compared. They are the safest of all grains. They form a loose mass in the stomach that can be easily digested, while such feeds as corn or barley tend to pack, sometimes causing colic.

Some horses are inclined to eat their oats too rapidly without thoroughly chewing. To prevent this, a little cut hay can be mixed with the oats, or a few smooth stones can be placed in the feed box.

Crushing oats. Whether or not it pays to crush oats for horses is a question often discussed. From experimental work it has been concluded the value of oats will be increased about five to ten per cent by crushing or coarse grinding. For horses with poor teeth, and foals up to one year of age, crushing oats is advisable.

Sheaf oats (unthreshed oats in the bundle) may be an economical feed for horses since the cost of threshing is saved and much of the straw is utilized. Care should be taken not to feed musty sheaves. To lessen the damage from mice, the sheaves should be stooked in the mow away from the hay.

Corn. Ear corn is safer to feed than shelled corn, for it keeps better and horses eat it more slowly and chew it more thoroughly. If corn is ground for horses with poor teeth it should be cracked or coarsely ground, as fine meal forms a mass in the stomach which is difficult to digest and may even cause colic.

Wheat bran is one of the most useful feeds for horses because of its bulky nature and mild laxative properties. If not more freely provided, its use once a week is desirable and may be fed as a bran mash.

Linseed meal is useful for bringing run-down horses into condition, and puts a bloom and finish on fattening horses. Up to one pound may be fed daily. From one-quarter to one-half a pound is very satisfactory.

Molasses is valuable as an appetizer or conditioner. It should be diluted with water and mixed with the feeds. One-half pint or even less per horse per day makes a very satisfactory amount.

HAY AND OTHER DRY ROUGHAGES

Mixed hays are much more satisfactory than timothy hay, which has long been considered the standard for horses. Mixed hay can be readily cured into bright hay, free from mould or dust. Experiments have shown mixed hays (timothy and some legume, such as alfalfa and red clover) have a higher feeding value for the farm work horse than has timothy, which has a slightly constipating effect.



A good farm team. Weight 3,200 pounds.

Hay cut too early makes "washy" feed for work horses, but it should not be allowed to stand too long before cutting. More hay is cut too late than too early.

Corn Fodder and Corn Stover

Properly cured corn fodder (ears attached) or corn stover (ears removed) may be fed to idle horses or those at moderate work. In fact it makes a very satisfactory substitute for part of the hay.

Straw is not suitable in large quantities for horses at hard work, but is very satisfactory along with other feeds for idle horses. Oat straw is the most satisfactory. Wheat chaff is quite frequently fed to horses.

Succulent Feeds

During the winter such feeds as carrots, turnips or mangolds may be fed. They are an aid to digestion. The horse at hard work should receive only a limited amount but idle horses and brood mares may be fed considerable quantities. Two or three mangolds or turnips daily, or an equivalent weight of carrots, are a fairly satisfactory amount.

Feeding the Work Horse

The amount of feeds necessary for a work horse will depend on the size of the animal, on the severity of the work, and also on whether he is an easy or hard keeper. A horse that is a hard keeper will need considerably more grain than an easy keeper when doing the same amount of work. Young horses that are still growing, and mares that are in the last half of pregnancy or those suckling foals, will need more grain than other work horses.

The amount of grain is usually divided equally into three feeds and given morning, noon and night.

A good practice is to feed one-quarter of the hay at the morning and noon feed and the remaining half at the night feed when the horses have time to eat it.

On coming to the stable at noon, the work horse should have a drink of water, care being taken if he is warm that he does not drink too much. Before going to work he should be watered again. If possible an hour should be allowed for the mid-day meal, and many good horsemen remove the harness so the horse can eat his meal in comfort and rest easily. This is not so necessary with the average farm horse that is working without a breeching. When using a harness with a breeching it is a good idea to put the breeching up on the horse's rump. This takes some of the weight off the collar during the noon-day meal.

When the horse comes in after the day's work, he should be given a drink, unharnessed at once, and when the sweat has dried, brushed well. Horses should be given a drink after the evening meal.

Rations for the Work Horse

A ration is the amount of feed given in twenty-four hours, regardless of the number of feeds. The ration will depend on the size and age of the animal and the severity of the work.



A useful type of horse for delivery and farm purposes. Weight 1,550 pounds.

One pound of hay and one pound of oats for each 100 pounds of live weight is a satisfactory rule for feeding horses at hard work. If the grain be decreased, the hay is slightly increased.

The suggested amounts of feed are for a horse in work condition. It is at once apparent that for a horse in high condition this might be too much feed. A horse on the average farm might weigh 1,500 pounds, and the same type of horse on another might carry sufficient fat to make him weigh 1,600 pounds or more. There is no hard and fast rule for feeding. It rests with the individual caretaker. A little grain fed regularly is much more satisfactory than too much grain on work days only.

Plenty of horses work and receive little or no grain, but in many cases this is false economy. There is no better whip for horses than some oats fed regularly.

These are only suggested rations:

RATION FOR 1,600-POUND HORSE
AT HARD WORK:

Mixed hay.....16-18 pounds
Oats.....14-16 pounds
Salt and water as required.

RATION FOR 1,400-POUND HORSE
AT HARD WORK:

Mixed hay.....14-16 pounds
Oats.....12-14 pounds
Salt and water as required.

RATION FOR 1,600-POUND HORSE
AT MEDIUM WORK:

Mixed hay.....18-20 pounds
Oats.....10-12 pounds
Salt and water as required.

RATION FOR 1,400-POUND HORSE
AT MEDIUM WORK:

Mixed hay.....16-18 pounds
Oats.....8-10 pounds
Salt and water as required.

RATION FOR 1,600-POUND HORSE
AT LIGHT WORK:

Mixed hay.....20 pounds
Oats.....8 pounds
Salt and water as required.

RATION FOR 1,400-POUND HORSE
AT LIGHT WORK:

Mixed hay.....18 pounds
Oats.....8 pounds
Salt and water as required.

Pasture

The man should turn the horse's head toward the gate while removing the halter, after which he should stand clear, since horses often kick as soon as they find themselves free.

The pasturing of horses during the summer at nights and on idle days will help keep down the cost of feeding. However, this is not always possible. The use of pasture grown in the regular crop rotation, instead of parasite-infested, permanent pasture, will help greatly to reduce infestation with internal parasites. Horses that are regularly worked may be turned out to pasture at night after they have eaten their grain. This practice in most cases reduces the cost, helps keep the horse thrifty and lessens the trouble from swollen legs. The pasturing should be regular and not intermittent, care being taken to gradually accustom the work horse to pasture. Horses that are pastured may sweat a little more readily while at work, but this is not injurious to a horse at farm work.

Feeding the Idle Work Horses

Maintaining the farm work horse in healthful condition during the winter is the first start in fitting him for spring. In as far as possible idle horses should be wintered cheaply, consistent with keeping them up in condition. Roughages used for this purpose may have little market value.

Of the straws, oat straw is the most satisfactory and may form a large part of the ration.

Corn stalks and bean straw have a place in feeding the idle horse.

At least five pounds of hay should be fed daily to idle horses. Two turnips or mangolds daily make a satisfactory succulent feed.

The average farm horse usually does some work during the winter and should receive a small grain allowance.

Regular work or exercise should not be overlooked.

Care of the Shoulders

When starting horses to work in the spring, care should be taken to see that the shoulders do not become sore. A little neglect may result in sore shoulders, but it is a difficult matter to heal them and keep the horse at work. Horses in good condition that are brought into work gradually are usually less subject to sore shoulders. It is a very good practice to wash the shoulders and neck with salt and water in the evening. A tablespoonful of salt in a quart of water is about the right amount. When too much salt is used the shoulders may blister.

Poorly fitting collars are usually the chief cause of sore shoulders. Standard collars will usually fit the average horse. Horses with well-shaped, sloping shoulders can wear a regular or full-face collar. There are, however, collars of different shapes. Horses with straight shoulders and wide necks may work well in a full or half sweeney collar. In some cases it may be necessary to have a collar made to fit the horse.

For farm work a collar that will allow the hand to pass between the collar and the bottom of the neck may be long enough, but for horses that are required to pull heavy loads a little longer one may be more suitable. At least, this would seem to be the observations from pulling contests.

The width of the collar is important. A wide collar may cause sore shoulders because it slips from side to side. The collar should fit fairly snugly along the side of the neck. Sufficient room is needed to push the fingers between the neck and the collar. Some adjustments can be made with the hames in order to make the collar fit more correctly. If sweat pads are required, a thin one is usually more satisfactory than a thick one which is more apt to become rough and ridgy.

The Horse at Work

If possible, a man should always work more than two horses. About one horse is required for every twenty to twenty-five acres of working land on the farm. The number of horses required varies somewhat with the type of farming.

The usual practice is to break the horse and work him as a three-year-old. Three-year-olds (mares or geldings) that have been properly fed should do considerable work.

Many good horsemen allow the colt to stand in the stable with the bridle and harness on a short time daily for a few days previous to hitching. He gradually loses his fear and will be less apt to kick. It is best to break him with a fast walking, even-tempered horse, and never hitch him to a load that does not move readily. In fact, as many good horsemen know, a little care and time at breaking may make a work horse more valuable.



The Six-horse Hitch demonstrated by the Animal Husbandry Department at the 1930 International Plowing Match. The horses are working efficiently, hitched to a tractor disc. Four of these horses were owned by the Corporation of the City of Stratford and two by a coal merchant. The off horse of the lead three was seventeen years old and had worked nine years on the city streets. Note the freshness of this horse. They are hitched together for the first time. Photo by courtesy of the Farmer's Advocate.

Two-year-olds are occasionally worked, but this may be easily overdone.

The size of horse varies to a certain extent with the size of farm and the type of land. Large farms and heavy land may require a little heavier horse. Generally speaking, a horse of medium weight will give the best results. There are too many horses with insufficient weight to perform work properly. Horses of the right type, weighing from 1,400 to 1,600 pounds, should be most satisfactory for farm work.

A horse starting to work should not be crowded for the first half-hour in the field. Likewise, a horse should not be too hot when brought in at the conclusion of the morning or day's work.

Occasionally, a horse breaks out in sweat and then for no apparent reason cools off quickly. This is frequently an indication of sickness.

Preparation for Spring's Work

Horses should be fed grain for at least one month previous to spring's work. If the horse has received no grain during the winter, begin with a small amount of grain and gradually increase.

Horses that have been gradually accustomed to feed and work will be in a much better condition to stand hard work.

A "green" horse—that is one not accustomed to steady work—fatigues much more quickly than a hardened horse, because his muscles are softer and carry an excess of fat. By working such a horse moderately, with properly spaced periods of rest, it is possible to build up the muscle cells so that he can do as much work as the seasoned animal. Rest gives an opportunity for the muscles to repair themselves. It should be remembered that fatigue increases with the square of the work done and not in direct proportion. Furthermore, there is a limit to continued muscular effort, and harmful fatigue can be avoided only by working the horse at a moderate speed, so as to keep a balance between the products of muscular activity and the ability of the blood to remove this waste material and provide fuel.

Care of Feet

Horses' feet need care in order to keep them in condition. The feet should be trimmed and shaped before spring's work. Under most circumstances, farm horses need not be shod, but this rests with the farmer.

Fitting Horses for Sale

The business of buying and fattening horses is not carried on to the same extent as it once was. At the same time, it should be kept in mind that work horses require to be in good condition to bring the best price. Under most conditions a horse of good type and serviceably sound is worth at least \$25.00 more than the same horse carrying little or no fat. Thin horses with long, shaggy hair do not present an appearance that attracts buyers, though they may be actually excellent work horses.

The same amount of feed is required to make 100 pounds of gain on horses as for other classes of stock. The risk is not much greater unless forced feeding is practised. Horses that are fattened up quickly and with a minimum of exercise usually lose the fat about as quickly when put to work.

In conditioning horses, boiled or cooked grain should form a part of the grain ration. A half-cup of flax may be added to each pail of feed for boiling. Boiled feeds are more easily digested.

Horses that are being fitted should be fed four times daily instead of three. The last feed at night may consist of boiled oats and barley (equal parts).

The amount of grain that may be fed depends on the skill of the feeder. A pound of grain, or even more, per hundred pounds of live weight, may be safely fed provided one-half of this is fed as boiled feed. Bran is especially valuable for fitting horses.

The importance of sufficient regular exercise should not be overlooked.

Regular and careful grooming add much to the appearance of the horse.

Possible Reasons Why Horses May Be Thin and Out of Condition

1. Overworked.
2. The ration, including water, too small or too large.
3. The ration unsuitable for the work being done.
4. The stable routine, the number of feeds, regularity of feeding, etc., may be at fault.
5. The horse may not be sleeping properly. A mature horse requires from five to seven hours sleep per 24 hours.
6. Something may be irritating him at work, such as sore shoulders, poorly fitting collars or bad handling.
7. The teeth may require attention. Does he slobber while eating?
8. Internal parasites may be the cause.

It may be necessary to consult a veterinarian to correct the condition.

Breaking Out

By "breaking out" is meant a secondary sweat after the horse has cooled off. The horse has well-developed sweat glands over his body and for this reason is especially suitable for work. A horse will frequently sweat from nervousness as well as work.

"Breaking out" may be caused by too hot stables, too much blanketing, too long a coat or, in some animals, by drinking too much cold water when hot.

Breaking out is not normal. Horses which are unfit or out of condition may break out in a sweat after severe exercise. Breaking out sometimes indicates pain which may be an indication of indigestion or colic.

Lameness

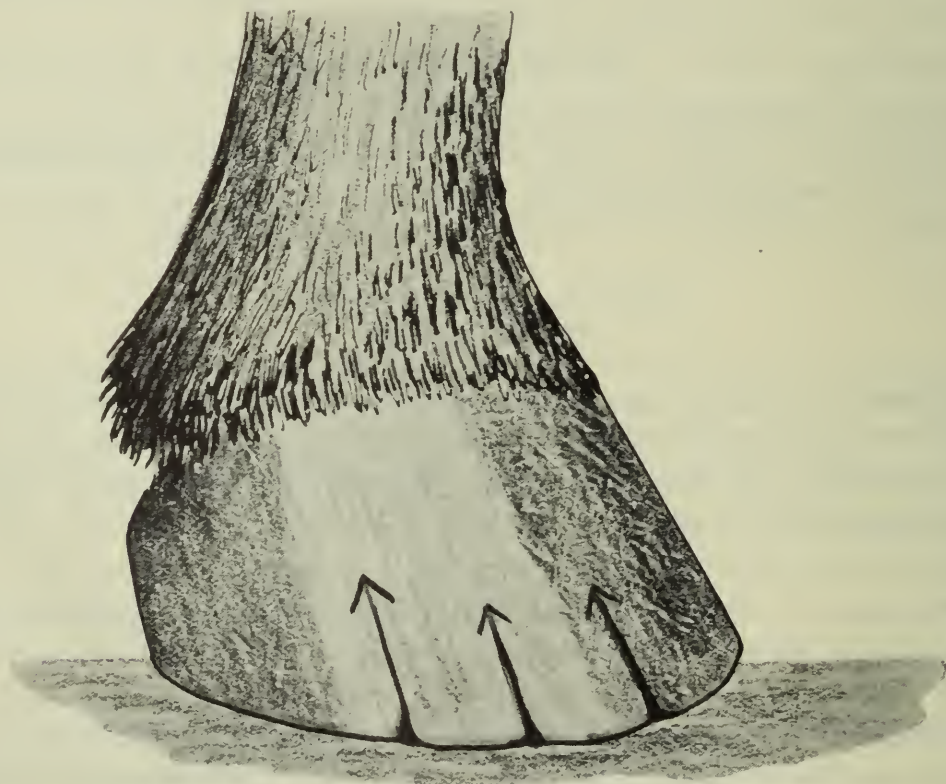
Lameness occurs below the knee or hock more frequently than any other part.

Certain types of lameness, such as is caused by a bone spavin in the early stages, may be "warmed out" of a horse. The horse will show lameness for a time after being taken from the stable, then it will disappear, but is again evident after the horse has stood for a time.

In locating lameness in the leg it should be kept in mind that it is the sound limb the horse puts down with the most confidence. If lameness occurs in the right fore leg the horse will throw his head up when the right, or lame foot, touches the ground.

When lameness occurs in both fore legs the action is stiff and stilted. The natural free stride is shortened. In most cases, the hind legs are picked up higher than is normal.

When a horse shows lameness in the front legs, if the trouble is in the shoulder the leg will usually be flexed at the knee when the horse is standing at ease. When sore on both front feet they are usually extended as far forward as convenient.



Drawing illustrating the method used in preventing hoof cracks from spreading.

Lameness behind may be noted by a drooping of the hip opposite to the one in which soreness exists when the horse is trotted away. When lameness occurs in both hind legs the stride is shortened and the horse has an awkward gait. The fore legs are raised higher than usual.

Cracks in the hoof may be the result of neglect in trimming the feet. Also, in some cases, it may be caused by the general practice of cutting out the heels in shoeing. This may be prevented by burning an inverted V at the top of the crack.

Thrush is usually found in the region of the frog, and a pungent odour is one of the chief signs. After cleaning it out thoroughly, it may be packed with calomel or burnt alum, or in the early stages pine tar may be used.

Legs occasionally become itchy, and the horse stamps considerably. Very frequently this is caused by small mites burrowing in at the roots of the hairs. The legs should be washed well above the hocks with warm water, using some soap. Repeat the washing in a month. Be sure to dry the legs thoroughly. Carron oil, which is a combination of olive oil and limewater, may be rubbed on the legs if washing is not convenient.

White lotion is frequently used in the case of cracked heel, and applied to the affected parts. It may be made by mixing acetate of lead (one ounce) and sulphate of zinc (three-eighths ounce), adding sufficient water to make one pint. White lotion should be kept in a glass bottle that is tightly corked. Shake well before using.

Heaves affect the ability of the horse to perform work, and are usually characterized by peculiar flank movements, caused by a normal inspiration (breathing in) and a double expiration (breathing out). Usually, in later stages, the horse has a cough.

There is no permanent cure. By reducing the roughage to a minimum and increasing the grain it is possible to make a badly affected horse more serviceable. When grass or roots are available, they may be fed in place of part of the hay to good advantage.

Dry feed should always be dampened before it is fed. Horses that are moved from a high to a low altitude may become touched in the wind. Likewise, it is claimed that horses suffering from heaves, when taken to a higher altitude, may be cured.

Heaves are not generally considered hereditary, but affect the economic value of the horse because of the inability to perform work properly.

THE HORSE BARN

Occasionally it may be necessary to remodel a horse barn or build a new one. The following points should be considered:

- | | | |
|--------------------|---------------------|------------------------|
| 1. Width. | 4. Alleys. | 7. Harness room. |
| 2. Ceiling height. | 5. Standing stalls. | 8. Stall construction. |
| 3. Windows. | 6. Box stalls. | 9. Floors. |

Width. One row of stalls requires 20 feet or more for alley, stall, manger and walk.

Ceiling height. The distance from the floor to the under side of the ceiling joists should be at least 8 feet, and $8\frac{1}{2}$ or 9 feet is preferable. Low ceilings are usually associated with dark, stuffy stables, and there is some danger of injury to stock. Provide at least 800 cubic feet or more air space per horse. A tight ceiling is always preferable.

Window space. In as far as possible the windows should be at the rear of the horses, and there should be about five square feet per horse.

Alleys. Feed alleys are made at least 3 or 4 feet wide. The litter alleys at the wall should be 7 feet wide or more.

Standing stalls. The standing stalls for work animals may be single or double. If space permits, it is better to have single stalls. A single stall for a draft horse should be 5 feet wide from centre to centre of partition and the length at least 9 feet in all. The top of the manger is 2 feet wide and the standing platform 7 feet long. The standing stall should be wide enough for a horse to lie down in comfort but not wide enough to encourage him to roll.

Box stalls. A box stall should be provided wherever more than two or three horses are kept. It is essential for sick animals, colts, or mares at foaling time, and should be at least 12' x 12'. The box stall should have a feed box and manger of a type that takes up as little room as possible and with no projecting corners. Dirt or clay floors are preferable.

Harness room. The harness room should be about the length of the stall and from 5 to 8 feet wide. The life of a harness is lengthened by affording it protection from stable air. Also, washing and oiling the harness twice a year will greatly increase its length of usefulness.

Stall construction. In horse stable construction everything should be solid and permanent. Stalls should be made tight to a height of about 4 feet,

and above this there should be a guard at the front of the stall partitions about 3 feet high.

The manger is built to a height of 4 feet on alley side and $3\frac{1}{2}$ feet on stall side. The manger should be about 2 feet wide at the top and 12 inches at the bottom, the whole manger being 12 inches from the floor. A slatted bottom allows dirt and chaff to drop on the stall floor.

The materials used in stall construction are wood, concrete and steel. Wood is the most common material used and should be of 2" plank, such as rock elm or any other tough, durable timber. Supporting posts should be 6" x 6", preferably oak.

Floors. The most satisfactory floor is concrete with the standing stalls overlaid with 2" plank. The stall floor is sloped 1" in its length toward the gutter. The gutter should consist of a slight depression rather than a distinct gutter.

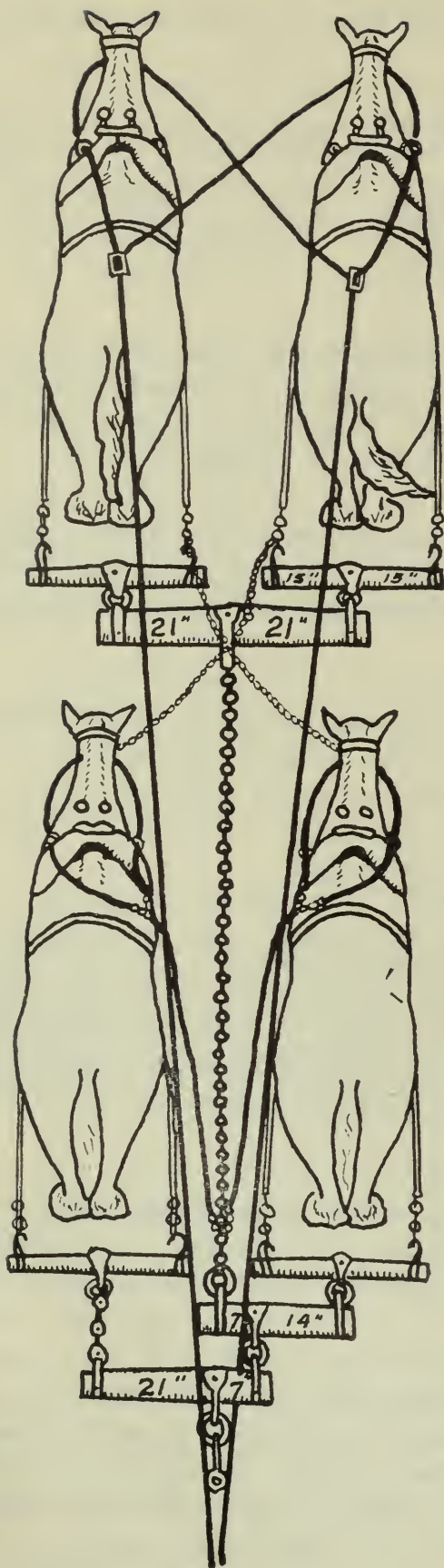
Another method of securing drainage is to make a gutter 8 inches deep and 6 inches wide and cover it loosely with a plank set flush with the floor.

MULTIPLE HORSE HITCHES

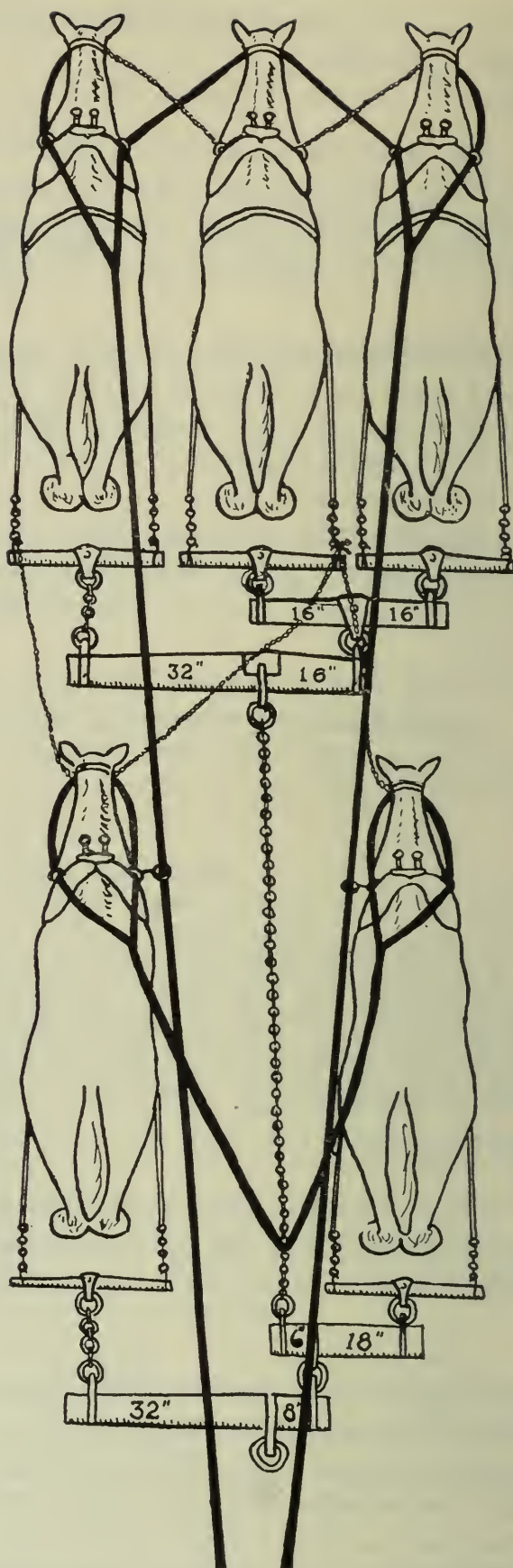
For several years there has been considerable interest in working larger horse units. The four and five-horse tandem hitches have a place on most Ontario farms. There is less crowding and tramping of feet, the horses are cooler, and no horse is required to walk on the ploughed ground. However, with implements such as the disc or harrow, when four horses are used, it is quite satisfactory to work them abreast.

The four-horse hitch illustrated in Fig. 1 is almost self-explanatory. In many cases this is all the horse-power necessary to operate a two-furrow riding plough. Most Ontario farms have at least this number of horses.

The five-horse hitch, Fig. 2, is very workable and practicable for Ontario conditions. This method of hitching is to have three horses in the lead and two on the wheel. In this hitch the nigh horse of the wheel team has about eighteen inches more neck yoke than his furrow mate. It will thus be seen that the wheelers are kept at a considerable distance away from the draw chain and also get more air. The nigh horse of the wheel team makes a very suitable place for working a brood mare or colt. Also, with this hitch, the driver has a full view of his horses, and there is less interference in turning.



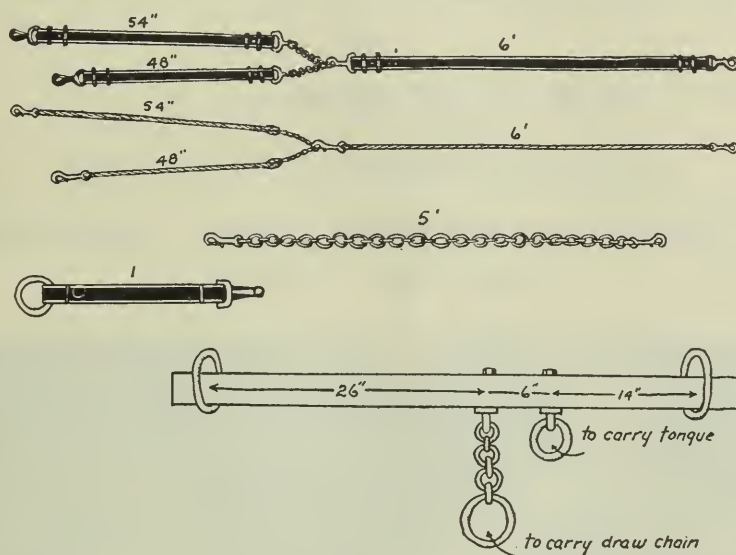
(Fig. 1) The Four-horse Hitch.



(Fig. 2) The Five-horse Hitch.

Special attention is called to the fact that only the lead horses are driven. The wheelers are tied in and bucked back. The tie or lead strap is snapped into the bit or halter ring. Fastening to the halter ring is preferable because it is easier on the horse's mouth. When the wheel horse is in the proper position, the other end of the tie chain is fastened to the singletree of one of the lead horses at an angle that will keep the rear horse walking straight ahead and keep him in place while turning. It should be fastened at a distance that will allow six to eight inches slack when the horse is working in a comfortable position, or with enough slack to permit the front singletrees to lie on the ground without bearing down on the heads of the rear horses.

In bucking horses back, a buck rope or strap is used. This snaps across the withers from one bit ring to the other. The longer section goes on the outside and crosses over the horse's withers. From the short connecting chain



(Fig. 3) Showing buck strap (rope or leather), tie chain, spreader and neck yoke for five-horse hitch.

a single strap or rope runs downward and fastens into the draw chain just back of the horse's hind leg; that is, where the horse is next the draw chain. If the horse is not next the draw chain, his buck strap fastens to the tug of the horse which has already been bucked back to the draw chain. This latter arrangement will only be necessary when six horses are driven.

When starting an outfit, notice whether any of the horses show a tendency to walk to one side or the other. If one does, simply snap the rear section of the buck strap into the correct link of the short chain between the front checks. This shortens or lengthens the two front checks the desired amount so the pressure on the bit will cause him to walk straight ahead. If the horse wants to head out, shorten the inside check, and if he crowds in, lengthen it.

The lengths of the buck straps are as follows: outside check, 54 inches; inside check, 48 inches; short connecting chain, 10 inches; and the part of the buck strap which fastens to the draw chain, 6 feet. On each end of this strap bolt snaps should be used, as it is much easier to fasten and unfasten them to the chains. The buck straps—rope or leather—tie chain, spreader, and neck yoke for the five-horse hitch are illustrated in Fig. 3. The eveners for any of these hitches may be made from 2-inch plank of any tough, durable wood.

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BREEDING AND MANAGEMENT OF DRAFT HORSES

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"College Lady" and Filly Foal

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BREEDING AND MANAGEMENT OF DRAFT HORSES

by

M. W. STAPLES, B.S.A., M.S.

THE horse has been used for agricultural purposes for many centuries. It is believed the horse was first used for working the land in Britain during the reign of William the Conqueror who began to reign in 1066 and reigned for twenty-one years. Tapestries, made during this time, show the horse hitched to a crude form of harrow.

The horse continues to be the main source of power on many farms. Moreover, the farmer has the necessary feeds at first cost, and can raise sufficient young horses to replace the old ones. The methods of feeding vary in different sections of the country. There is no one best way under all conditions. Available feeds, nature of the work and climatic conditions all have a bearing on how horses should be fed.

Ontario can produce as good horses as any country in the world. A little thought, however, is required in the production, marketing and general use of horses. Perhaps the aimless hit or miss system in breeding and feeding has been too much in evidence. The aim of every horse breeder should be to improve the quality of the horse and not just increase the numbers. Only the soundest and best type stallions should be used. No horse breeder should be governed by the service fee.

SELECTING THE STALLION

Stallions usually represent a large investment; therefore, they should be selected with extreme care.

Soundness is most important and should **not** be overlooked.

Size and quality are also important factors. Mature draft stallions in good condition should weigh 1800 lbs. Not only should the stallion stand correctly on sound feet and legs but he must have a natural thickness. In other words, he must have two good ends joined by a good middle.

The head is very important since it shows much of the sex character. A stallion's head is somewhat larger and bolder than a mare's and has a distinct masculine appearance. The neck should be long and well crested with a clean throat latch.

The bodies of stallions should be deep, wide and muscular. Their shoulders should be long and sloping, their chests deep and wide showing a strong constitution. The back should be short and strongly coupled. The flank should be deep indicating feeding capacity.

The feet and legs should not be overlooked. The feet should be large with wide heels and open hoof heads, the pasterns long and sloping (about 45°) and the cannon bones should be wide and flat with well defined tendons. It is essential that stallions show more substance in bone than mares. Well set hocks that are wide, clean and strongly supported are important.

At the walk stallions should move with a long, straight, free stride. At the trot their action should be bold and powerful with free flexion of the knee and hock. While close hock action is desirable it should be kept in mind that a horse with natural thickness may not go as closely as the "pony thigh" undesirable type of draft horse.

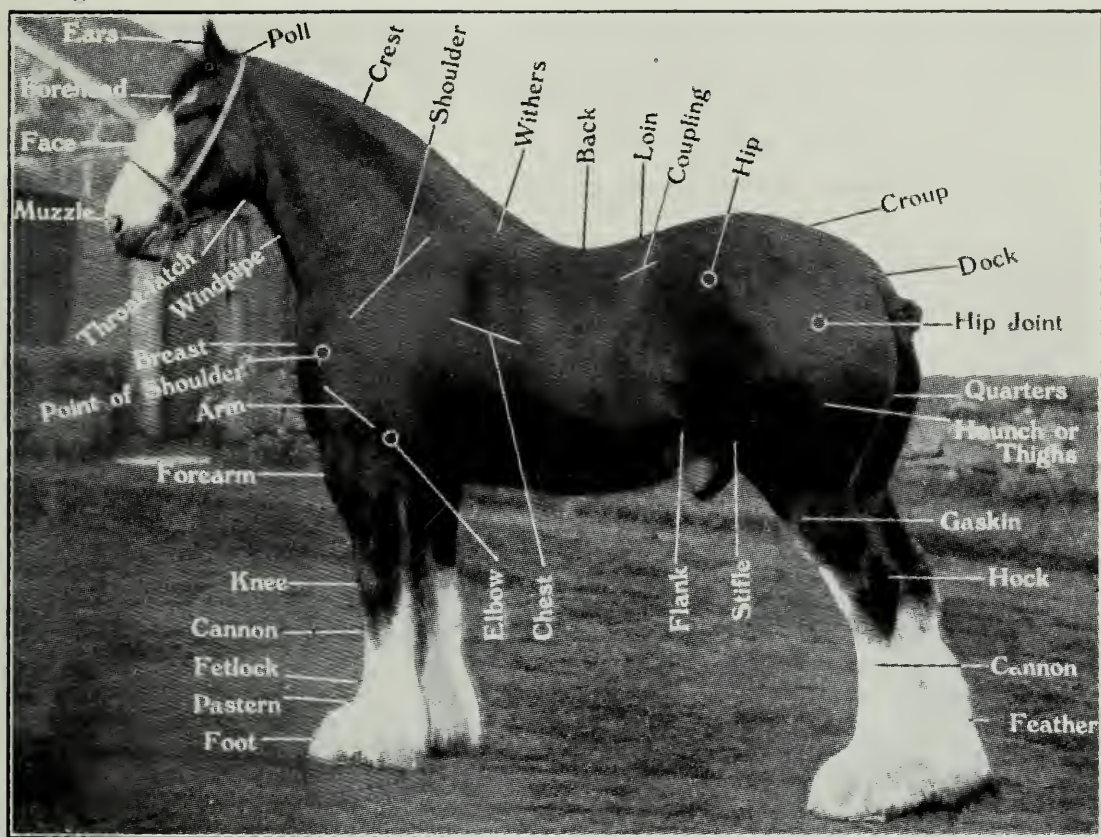
The feeding and care of the stallion has a great deal to do with his success at the stud. He must be kept in good condition, but will not give best results if over-fat. Careful feeding and plenty of exercise, regular and sufficient grooming and sensible regulation of services are essential to success.

The ration of the stallion at heavy service will be quite similar to a horse at hard work. Oats, bran and mixed hays are very suitable. The total amount of feed required will depend very largely on his temperament, the number of services, and the exercise he gets. It is advisable during the breeding season to feed four times daily instead of three but giving the same total amount of feed. A warm bran mash may very well replace the last grain feed on Saturday night, especially during the breeding season. His care and management for the two or three months previous to the breeding season will have a very marked effect on his power to beget foals.

Regular exercise is most important. This may be done by leading a certain distance daily, or by paddocks or in off seasons by working. Stallions that work steadily cannot be expected to go quite so closely. Work has a tendency to open the thighs.

Age to breed. A well grown two-year-old stallion may be bred to a limited number of mares, not more than ten, and as a three-year-old not more than fifty mares. More services than these may impair his usefulness for life. The number that may be bred, of course, will depend on the length of the breeding season. Usually, however, it only lasts eight or ten weeks. It is almost impossible to lay down any hard and fast rules re the number of services for a mature stallion. The stallion owner should remember that the reputation of his horse rests not upon the number and

quality of mares he breeds, but upon the number and quality of foals he leaves. One hundred mares is generally considered a fairly heavy season depending on the length of the breeding season.



The names and location of the points of a draft horse.

SELECTING BROOD MARES

In selecting brood mares, regardless of the breed, one should keep certain points in mind. Good brood mares should be sound, of good size, type and form. They should have big feet, well-set legs, with clean flat bone. They should possess a breedy appearance by being deep ribbed, roomy, with a strong constitution and show style, femininity and refinement about their necks. Big, coarse, plain mares are seldom as good breeders as the medium sized mares that possess quality, style, breeding and refinement.

The mare should be mated with the soundest and best stallion available. By "best" is meant a horse that is particularly good where the mare is lacking and has no outstanding faults. Under the Ontario Stallion Enrolment Act 1927, all stallions are graded. Reference to the Forms of stallions, as defined by the Act, is made elsewhere in this bulletin. The top grades of stallions should be used but the Form IV should not be used. He has little to recommend him as to soundness and conformation.

AGE AND TIME TO BREED

To have a successful brood mare it is best to breed her as a three-year-old and keep her breeding regularly. Some well developed, pure-bred mares are bred as two-year-olds but they are seldom worked while suckling their foals. On the other hand, it is not advisable to let mares get too old before they are bred or they may never raise foals. It should be kept in mind that over-fat mares are usually not the most successful breeders and, likewise, mares should not be too thin.



College Queen, College Belle and College Lady, First Prize Get of Sire at 1936 Royal; Second and First Prize two-year-olds, respectively, and Fifth Prize three-year-old. Bred and exhibited by Ontario Agricultural College.

The gestation period of the mare is approximately eleven months or 340 days. It is usually better to breed the mares toward the end of the heat period which lasts from four days to a week or more. During the season of 1931 six of the College mares were trucked to six different stallions and brought back the same day. The greatest distance was about one hundred and eighty miles. Four of these were young mares that had never been bred, one was a yeld mare and the sixth was a brood mare bred at the "foal heat". The five mares were tried each day and were trucked away on the fourth or fifth day. All of these mares proved in foal.

Brood mares are frequently bred at the "foal heat", usually on the ninth or tenth day after foaling. This, however, varies with mares a day

or two either way. It is believed by many that they get in foal a little more readily when bred at this time than subsequent heat periods. **Do not breed on the ninth day unless the mare is clean and healthy.**

About eighteen days after the mare has been bred she should be tried and continue to try her every other day until the twenty-fourth day. Then try her once a week until she has passed nine weeks. A gelding may be used to try the mares if a stallion is not available.

FALL FOALING

Occasionally it may be necessary to have a foal born in the fall, preferably October or November before cold weather begins. This may be advisable, especially when a mare is required to do a heavy summer's work. Mares nursing foals during the winter months require a little extra feeding. Also, it is necessary to allow the foal access to water. He will usually begin to drink about the same time as he learns to eat.

FEEDING AND MANAGEMENT OF THE BROOD MARE

Skill and good judgment enter into the success of feeding and caring for in-foal mares. If a few necessary rules and precautions are observed, coupled with good judgment at all times there should be no difficulty in maintaining mares in good condition for breeding.

There are a number of points one should observe in the feeding and management of horses and especially in-foal mares.

1. The order of allowing water and feed. The correct practice would seem to be water first and feed afterwards. When horses are working hard it would be well to water before feeding and again on taking them to the field. Likewise, horses should have opportunity to drink after they have had the evening meal. Ice cold water should be avoided. An over-heated mare should never be allowed to drink "her fill".

2. Avoid all sudden changes in feeding and also in degree of work. The importance of exercise for the in-foal mare either at work or in the paddock can not be over emphasized. Moreover, the sunshine which the mare receives is very beneficial.

3. Avoid mouldy or dusty feeds. Mouldy feeds will frequently cause poisoning and are especially dangerous when fed to in-foal mares.

4. Minerals.

Salt is absolutely essential for horses. It should be kept before them at all times.

The in-foal mare in addition to salt should receive a little less than a level teaspoonful of Potassium Iodide twice a month during the winter months beginning with the month of October. This may be given in the drinking water, care being taken to mix it with one-half pail of water in order to make sure that the mare gets all the Potassium Iodide.

If the mare is getting good feeds, such as mixed hay, oats and bran it is not likely that she will require a mineral mixture. However, equal parts of salt and bone char make a very satisfactory mixture. Feed it as you would salt.

PREPARATION OF THE FEED

The crushing of oats may have little value for horses with good teeth but for old horses and foals it is advisable. It is important that the oats be regularly fed, either crushed or whole. Oats containing small quantities of either wheat or barley should be crushed or coarsely ground.

Cooking grain is not so generally practised as it once was. Larger quantities of cooked grain may be fed with safety. For this reason boiled feed is very frequently fed to horses being conditioned for show or sale. If, to this grain for boiling, a small quantity ($\frac{1}{3}$ to $\frac{1}{2}$ cup) of flax has been added the boiled feed is still more satisfactory.

Cutting or chafing hay or straw makes it possible to combine it with the grain ration. The grain is often mixed with part of the cut hay which forces the horses to eat the grain more slowly. If to this is added a quantity of molasses the palatability is still more increased. Larger quantities may be fed, but one-half pint diluted in water is satisfactory. Cut feed and molasses have a place in fitting and showing horses but are not essential. Cut feed must be free from mould.

WINTER MANAGEMENT

Joint ill or navel-ill is one of the chief causes of losses in young foals. In cases where mares have produced foals that developed joint ill in previous years it would be well to have such mares inoculated with a suitable vaccine. Get in touch with your veterinarian in order that he may arrange to get the vaccine which is, at present, supplied by the Ontario Veterinary College.

As previously stated the importance of exercise for the in-foal mare can not be over emphasized. The working of the brood mare is to be recommended. However, the man who works her should use good judgment. There is a difference between working and abusing. Pulling too

hard, backing heavy loads, wading through deep mud or snow or over exertion must be avoided. Preferably, she should not be worked one week previous to foaling. She should, however, be turned out in a paddock in order that she will get exercise. There are many cases where mares have worked up to the day of foaling without harm.

Feeding an in-foal mare that is worked is simpler than feeding an idle one. The chief essential is a well-balanced ration containing plenty of protein, the muscle forming nutrients and minerals, chiefly calcium (lime) and phosphorus for the development of bone and muscle. These are well supplied by home-grown feeds. Mixed hays, oats, bran and roots are satisfactory feeds for in-foal mares. The amount fed during the winter and spring months will depend largely on the condition of the mares, the age, and the amount of work being done. During the winter good clean oat straw, corn stalks or bean straw may take the place of part of the hay. Turnips or mangels make a very satisfactory succulent feed, about two mangels or turnips per day.

Constipation is frequently a source of trouble as foaling time approaches. Many mares foal at grass time and nature helps take care of this. The day or two previous to foaling the amount of oats fed should be greatly reduced and the amount of bran increased. This is better fed in the form of a bran mash because it has a more laxative effect when fed as a mash.

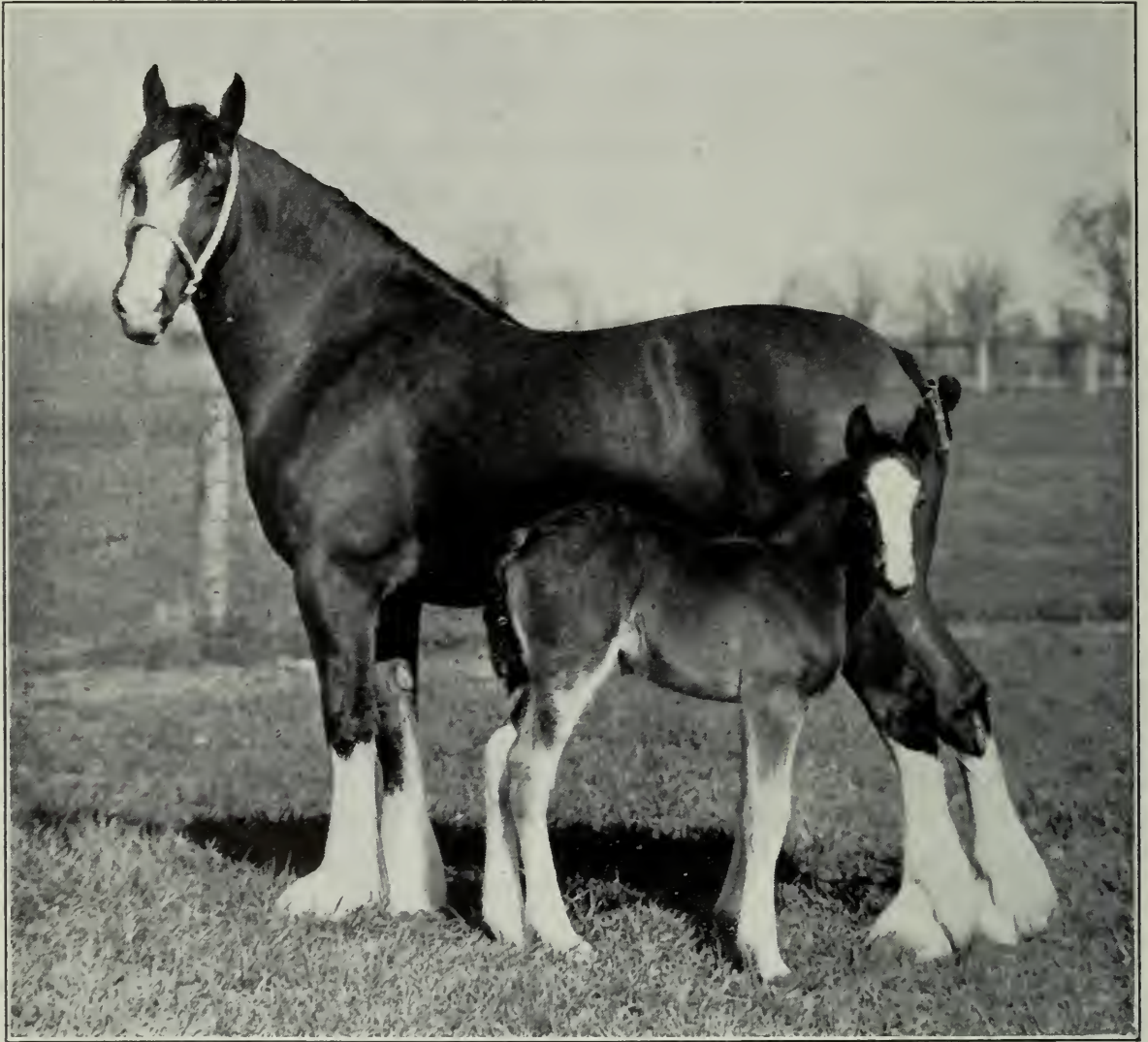
The formation of wax on the teats indicates that the foal may be expected within a few days. Usually, the foal is born within twenty-four hours after the appearance of the milk-like wax. This is only one of the many indications that foaling is near at hand. Sometimes there is a filling of the udder and teats and no wax formation. It is a bad practice to take a little milk from the udder to determine about when the mare will foal. This may stimulate milk secretion too soon and the mare may lose the milk so necessary for the new-born foal.

Swelling of the legs and abdomen is common as foaling time approaches. The mare at foaling time should be kept in a well-lighted, roomy box stall that has been cleaned and disinfected. Plenty of fresh clean oat or wheat straw makes a satisfactory bedding. The shoes should be removed several days before foaling.

For the first day or two after foaling the chill should be taken off the drinking water in cold weather. As soon as the mare is on her feet she should be given one-half pail of water. A warm bran mash (about one gallon) is very satisfactory for the first feed. In fact, on account of its

laxative effect bran should form one-half of the grain ration for the first week. It is well, in most cases, to feed the mare rather sparingly for a day or two.

If a mare foals on grass the feeding and management is much simpler. The number of hours she may be kept out will depend largely on the weather as the very young foal should not be allowed to lie on the cold ground. On the other hand, foals born in the late summer may suffer from too much exposure to the sun.



Hester, Hiawatha [57814] and filly foal. One of the Clydesdale brood mares at the Ontario Agricultural College.

Retained afterbirths in mares are not very common but are rather dangerous. If not properly attended to it may result in difficulty in getting the mare in foal again or other serious complications, such as founder. Occasionally, where the mare has become overheated at foaling

it is advisable to blanket her in order to prevent her from taking a chill. In the case of a retained afterbirth it would be well to get in touch with a qualified veterinarian if it has not come away in from six to eight hours.

THE FOAL

With the young foal cleanliness is necessary. The navel should be disinfected with any reliable disinfectant daily until healed. A two and one-half per cent. iodine solution is quite satisfactory. It is not a good practice to cut the foal's navel with a knife and tie it. It will usually break itself and will not bleed so freely as if cut with a knife. The navel, in most cases, should not be tied because it will drain more readily and heal better. Sometimes one is inclined to tie the navel because it looks abnormally large but this, in most cases, is due to a congestion of the blood in the umbilical (navel) cord. In most cases, the navel ruptures itself when the foal moves about or when the mare gets up. Of the foals born at the College in the last ten years it has been necessary to tie only one foal's navel to prevent hemorrhage. Usually, if the navel is tied the string should be cut after about twenty-four hours. It is well, if possible, to clean the box stall out immediately the mare foals. This is the practice followed at the College. The box stall is cleaned or a corner of it is cleaned and fresh bedding is put in and the foal is put over on the fresh bedding and the remainder of the stall is cleaned and bedded.

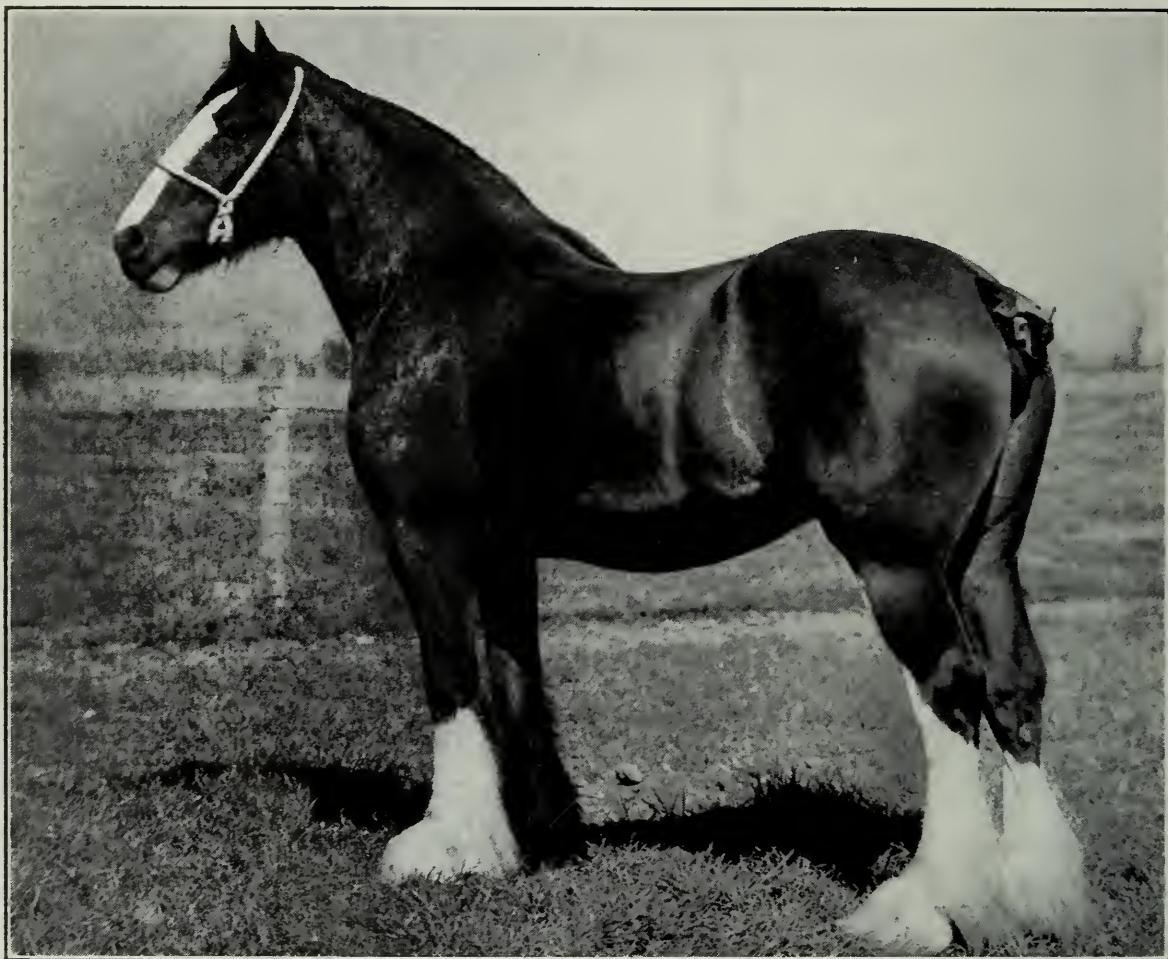
The navel stump should be watched to see if it is healing. In case of a leaking or damp navel stump it would be well to have it treated at once. A stiffness or soreness in one or more of the legs or joints is very frequently one of the symptoms of joint ill, especially if it is accompanied by a temperature.

Some foals are on their feet shortly after they are born. The foal should get some of the colostrum or first milk soon after birth. Usually, it will have one or two sleeps before nursing. As a rule the foal will nurse without difficulty but, at other times, it may require considerable patience to get it started. It is better not to let the foal go too long before nursing and it may be necessary to get some of the mare's milk in a bottle and using a large nipple feed the foal in this way. If the foal has difficulty in nursing one should always feed it underneath the mare's flank and in time it will nurse. In the case of a weak foal, usually, after a small feeding it will have a sleep before attempting to get up.

Foals should be watched for any signs of constipation such as arching the back and straining. It may be advisable to give a tablespoonful of castor oil which should be mixed with a little of the mare's milk. Also,

it may be necessary to inject warm water (about one-half pint) into the rectum. The water should be at body temperature and an ordinary syringe may be used.

In case the foal dies care should be taken in drying the mare. It may be necessary to occasionally draw milk by hand. Feed the mare rather sparingly and, in most cases, no difficulty will be experienced. A little camphorated oil may be rubbed on the udder. This will help remove the swelling.



*Brunstane Fiona [57813] First Prize Clydesdale brood mare at 1936 Royal.
Owned by the Ontario Agricultural College.*

WORKING THE BROOD MARE

Under farm conditions it is often possible to allow the brood mare and foal to run to pasture during the summer months and begin to work the mare at harvest time or early fall. However, this may not be possible. Preferably, she should not be worked from three weeks to one month after foaling. When the mare is working the foal should be kept in a

cool dark stall during the day time and turned out to pasture with its dam at night. It is very important that the overheated mare should not be allowed with the foal until part of the milk has been drawn by hand. Too much milk from the mare in such a condition will often cause scouring. When the mares are required to work it is well to see that the foal gets some rolled oats and bran, (three of oats to one of bran), slightly moistened. Usually, the foal will begin to eat at three weeks to a month of age.



Six-horse team. Four of these are three-year-olds, and the nigh lead horse is ten year old. Bred and owned by Ontario Agricultural College.

RAISING THE ORPHAN

Occasionally a mare dies or has no milk and it is necessary to raise the foal on cow's milk. This may be done but requires considerable patience and care. Choose the milk from a fresh cow giving a low percentage of butter fat. To a tablespoonful of brown sugar add warm water to dissolve it, then three to five tablespoonsful of lime water and enough fresh milk to make a pint. Feed about one-fourth pint every hour for the first few days, always warming to blood heat. An ordinary nursing bottle and nipple is quite satisfactory. After a few days six feedings will be all right and later on four. Teach the foal to drink as soon as possible. At three to four weeks the sugar may be stopped but the lime water should be continued. In five or six weeks sweet skim milk may gradually replace the whole milk. At three months of age the foal may be given all it will drink three times daily. The foal should be taught to eat such feeds as crushed oats, bran, and grass or legume hay.

Lime water may be made by dissolving lime in water and allowing it to stand for several hours. Pour off and use only the clear liquid from the top of the container. This should be kept in bottles that are tightly corked as the lime water will gradually lose strength when exposed to the air.

WEANING

The foal should be weaned at from four to six months of age. If he has been taught to eat while with his dam, weaning may be done without any serious setback. Since a foal makes about half its growth the first year it is most important that it be properly fed. Bone and muscle-forming rather than fattening feeds are necessary. The ordinary home-grown feeds including mixed hay, oats, carrots and mangolds or turnips are very suitable.

Regular exercise is equally as important as the feeding. The exercise helps develop the bone and muscle and keeps the legs right. Colts that are turned out daily are less apt to develop stable vices, such as cribbing, than those that have nothing to do.

What mixed hay they will eat and from three to seven pounds of grain made up of three parts crushed oats to one part bran is fed daily. At the beginning of the winter they get about three pounds of this grain mixture and by spring this has been gradually increased to six or seven pounds.

During the second winter the colts are fed what hay they will eat and from six to ten pounds of grain (oats and bran) daily. Also, two mangolds and turnips are fed per day.

Oat straw, corn stalks, bean straw and feeds of this kind may take the place of part of the hay. These are more suitable for feeding the yearling than the weanling.

SUMMER MANAGEMENT

The yearling and two-year-olds should be turned to grass early in the spring. It is usually not necessary to feed grain on grass unless fitting for show or when the grass is poor.

AGE TO CASTRATE

Colts not intended for breeding purposes should be castrated the spring that they are one-year-old. If done before this there is usually a lack of development of the fore quarters. However, it is seldom advisable to leave them entire more than one year as they often become troublesome. It is best to have it done at grass time and before the flies get bad.



*Shirley Supreme, First Prize two-year-old Belgian filly at the 1938 "Royal".
A typical Belgian, bred and exhibited by Haas Bros., Paris, Ontario.*

CARE OF THE FEET AND LEGS

The statement has been made "that seventy per cent. of a horse is his feet and legs". The feeding and management of the colts should tend to produce not only a good body but feet and legs with the proper wearing qualities. The regular trimming of the colt's feet will influence, to a certain extent, the kind of feet he will have as a mature horse. Care should be taken to keep the heels as wide as possible. The handling of the feet should begin when the foal is young and the trimming will be a simple matter.

The feet and legs should be viewed from the front and side to determine the correct shape before the trimming is done.

As a rule it is not necessary to begin trimming a foal's foot until he is two or three months old. A new born foal has a soft, horny material on the bottom of its feet. This usually sluffs off in a few days. In a short time it will be noted that the feet are growing larger near the hoof head.

The new growth soon takes the place of the old, and the feet have more spread to the heel, more slope to the walls and are rounder. If the feet are not wearing evenly at this age, a hoof knife or rasp can be used to level them up. In fact, by trimming, much can be done to straighten crooked feet and sometimes incorrectly shaped pasterns and legs.

The feet need constant care in order to keep them in good condition. Feet that are regularly trimmed seldom have quarter cracks nor do they cause much trouble. Usually the feet should be looked at and shaped every six weeks.



Moulton Jewell 3rd [317]. A prize winner in England. Imported and owned by G. W. McLaughlin, Oshawa, Ontario. This mare is the dam of Stonehaven Boadicea, First Prize two-year-old and Junior Champion Suffolk mare at the International Live Stock Show, Chicago, 1938.

The frog is soft and spongy in texture and acts as a spring in relieving concussion, when the foot comes in contact with the ground. In order to keep this organ in a healthy condition, the horse should be shod so that the frog comes in contact with the ground at every step. It is sufficient to remove any ragged portions as this organ sheds of itself.

The sole is made of a hard, horny substance and acts as a protection to the lower surface of the foot. It is thickest at the toe, gradually becoming thinner toward the heel. It should not be burned or whittled in shoeing. The sole should be concave not convex.

By the use of a hoof knife remove any dirt or loose material from the bottom of the foot. Examine to see if there is any indication of thrush. This usually results from lack of care of the feet. The symptoms are the discharge of a dark coloured pus from the cleft of the frog and has a very offensive odour. The treatment in the early stages consists of cleaning away all loose portions and packing it with pine tar. A thrush powder for packing in the cleft of the frog may be procured from your local veterinarian or a drug store.

The next step is to take the hoof cutters and nip the hoof wall down to about the same level as the sole. Then take a rasp and smooth off the rough places. Make sure the heel and toe are the right length to give the foot the correct shape. When the bottoms of the feet are finished, hold the foot in front of the colt and with the rasp round off the walls at the lower edge.

Occasionally, the feet become dry and hard. In such cases it is a good practice to pack the shoes at night with a little moistened blue clay or, in severe cases, have the horse stand in it for several hours. Hoof ointments also serve to keep the feet in good condition. Some paint the horse's feet with the waste oil drained from cars. This, however, contains some gasoline which may have a drying and hardening effect on the feet. In fact it may do more harm than good.

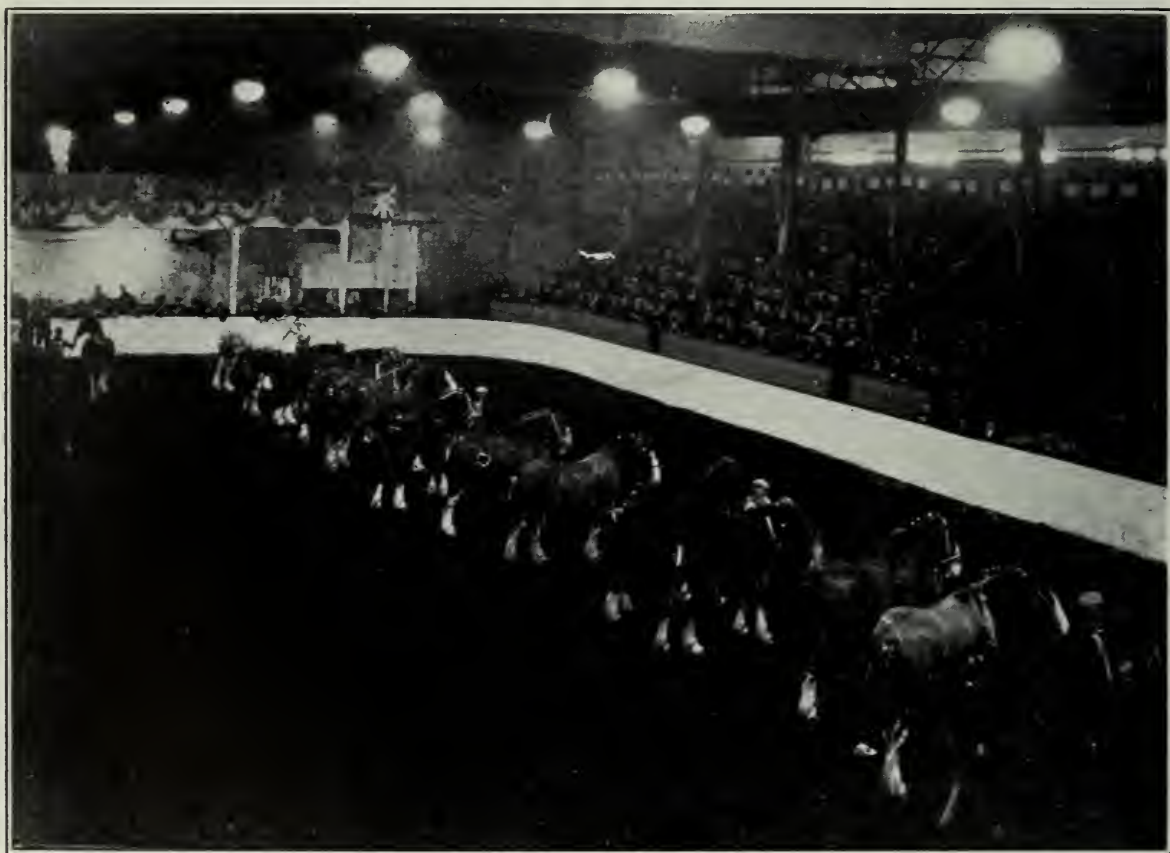
Sometimes there is a tendency to feed colts in racks or high mangers. In as far as possible they should be fed hay out of a very low manger. A colt that is inclined to be weak in the knees will often strengthen when fed this way, and the trouble is only aggravated when he is compelled to reach up for his feed.

TRAINING AND SHOWMANSHIP

The age of a horse is computed to the first of January. This means a foal born in the fall must be shown the following year in the yearling class although he may not be one year old at the time of showing.

In leading a horse one should always be on the left side. Keep to the outside when turning as there is less danger of being tramped or kicked leading him this way. No colt that has not been properly halter broken should be taken to a fair. The place to school him is at home.

Some showmen seem to think that a horse is not correctly shown unless he is prancing and taking short choppy strides. It should be kept in mind that the draft horse is required to do most of his work at the walk. For this reason a judge prefers to see a horse move with a long free easy stride. Also, at the trot the mistake is often made of urging him beyond his speed. It is, also, possible to move a horse too slowly. Others are not sufficiently careful when turning the horse before the judge. The horse is turned in a semi-circle and no attempt is made to move him straight from the judge. This may give the wrong impression of action. A good showman usually turns the horse and then stops before leading him away.



A group of Clydesdale mares and geldings in the ring at a recent Ontario Provincial Winter Fair. These were bred and exhibited by Ontario farmers.

Occasionally, the appearance of the draft foal is marred by the clipping of the fore top and mane.

At some shows one sometimes finds a man showing the same horse in the Heavy Draft and Agricultural classes. Such should not be permitted because it is at once apparent that the same horse cannot be both

heavy draft and agricultural. Some horses are just on the line so far as weight and type are concerned and might be shown in either heavy draft or agricultural, but not both.

In judging draft horses it is usually not necessary to know the exact height as is the case in some light horse classes where this forms a basis for classification. The height is measured at the highest point of the withers and is stated in hands and inches. A hand is four inches. In taking the height a horse should stand on a perfectly level floor. The fore legs and hind legs should be as perpendicular to the floor and as parallel to each other as the conformation of the horse permits. Also, the head of the horse at the poll should be in line with the withers. It should be noted that the spirit level in the cross bar of the standard should indicate that it is being held properly.

THE ONTARIO STALLION ENROLMENT ACT, 1927

The Director of the Live Stock Branch of the Department of Agriculture is the secretary and an executive officer of the board. His address is Parliament Buildings, Toronto.

The following is a brief summary of the Act:

1. No person shall stand, travel or offer for use or sale any stallion unless the same is pure bred and until such stallion has been enrolled and the certificate of enrolment has been issued.

2. Any newspaper or printed advertisement issued to advertise a stallion shall include in prominent type the grade of such stallion as fixed by the board and the date of expiration of the certificate.

3. Upon request the owner of the stallion shall exhibit to the owner of each mare, at the time of service, the original enrolment certificate issued for such stallion.

4. Each owner of a stallion shall transmit to the Secretary of the Board a copy of every poster or other advertisement issued. In default of compliance with this regulation, the Board may cancel any certificate issued for such stallion.

FORMS OF CERTIFICATES ISSUED

Form 1 or First Class Enrolment Certificate.

This is the highest grade and may carry an A Premium certificate.

Form 2 Second Class Enrolment Certificate.

This is the second highest grade and may carry a B Premium certificate.

Form 3 Third Class Enrolment Certificate.

Form 4 Fourth Class Enrolment Certificate.

NOTES REGARDING REGULAR INSPECTION

(1) No person can lawfully stand, travel or offer for use or sale any stallion unless the same is pure bred, and until such stallion has been enrolled and the certificate of enrolment issued.

(2) A stallion must be inspected at least every third year as long as he is used for public service.

(3) Any stallion which has never been inspected either because he is a colt just coming into service, or a mature horse just imported into the Province, requires inspection.

NOTES REGARDING FEDERAL-PROVINCIAL PREMIUM

No premium is paid on stallions leaving less than fifteen mares in foal in a season.

(1) Any stallion, in order to be granted a Federal-Provincial Premium must be a good specimen and typical of his breed, be free from hereditary unsoundness, possess size, good conformation and action.

(2) Any stallion within the Province at the time of the regular inspection, as determined by the Ontario Stallion Enrolment Board, must be presented to the Ontario Stallion Enrolment Board Inspectors to be eligible for inspection by the Federal Inspectors, whose inspection will follow as closely as possible after the Ontario inspection.

(3) Any stallion owner whose stallion is not recommended for a premium and who feels that his stallion should have been recommended, may appeal to the Secretary of the Ontario Stallion Enrolment Board for

reinspection by the Reinspection Committee as provided for hereafter, on filling in an application and forwarding same to the Secretary of the Ontario Stallion Enrolment Board not later than March 1st, and making a deposit of \$25.00, which will be returned to him if his appeal is sustained and which will be forfeited if his appeal is lost. The appeal shall be brought before a Reinspection Committee made up of one Inspector representing the Federal Live Stock Branch, one Inspector representing the Provincial Live Stock Branch, and a third Inspector whom the Federal and Provincial Departments of Agriculture shall jointly invite the Provincial Department of Agriculture to appoint from an outside province.

(4) No stallion shall be granted a premium until he is entered upon season as a three-year-old or over, and any stallion granted a premium on his three-year-old season shall be reinspected for premium as a four-year-old. A stallion four-year-old or over at the time of inspection for a Federal-Provincial Premium may be granted a premium during each or any of the next succeeding three years without further inspection, if such stallion is enrolled yearly before May 1st of each year, and if in the opinion of the Federal-Provincial Board further inspection is not required.

(5) Any stallion to obtain a Federal-Provincial Premium must be enrolled in the office of the Secretary of the Ontario Stallion Enrolment Board, Parliament Buildings, Toronto, before May 1st of each year.

(6) Each owner of a premium stallion shall be required to keep in a book supplied, a record of the mares bred to such premium stallion, giving name, and description as to colour, age and markings of each mare. Report of mares bred to be returned to the Secretary of the Ontario Stallion Enrolment Board on or before March 1st, on forms to be supplied.

“The Ontario Stallion Enrolment Act”, 1927, states:—

“The following shall be considered diseases or malformations, as the case may be, under these regulations: Bone spavin; curb, when associated with a formation of hock which predisposes to curb; bog spavin, when associated with a formation of hock which predisposes to bog spavin; ring bone; string-halt; side bone; roaring or whistling; periodic ophthalmia; navicular disease; and radical defect or defects or general defectiveness of conformation rendering the stallion unsuitable for use in the stud.”

Bone Spavin—The hock should be carefully examined because this is likely to be the hardest worked joint of the body. The most common trouble and worst of all is the bone spavin, frequently called jack spavin. Bone spavin may be caused by anything that produces inflammation, for example, **Faulty Conformation** and mechanical injuries of the hock, either from blows or kicks or from too rapid and hard work on paved streets.

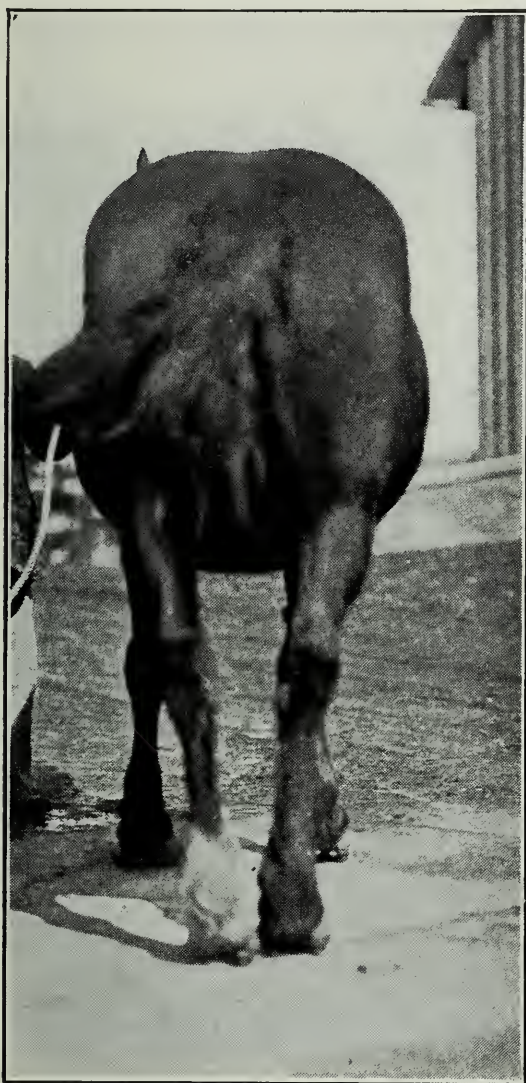
To detect a spavin it is best to stand in front of the horse so that one is able to see the inner outline of the hock. Bone spavin consists of a bony deposit which nature has thrown out to strengthen an otherwise weak joint and when it has developed it ties the joint so that it interferes with the proper action of the horse. The hind leg instead of coming down on the heel as it should in a sound limb, is thrown forward so that the toe reaches the ground first and the stride is unnaturally shortened and lameness frequently results.



A well developed bone spavin. It may be plainly seen on the inside of the near hock. Note the short round conformation of the hocks which predisposes to unsoundness.

Occult spavin is very hard to determine since the deposit is not apparent to the eye but hidden in the joints. The horse, however, will go lame on being taken from the stable. In the early stage the lameness may disappear after considerable exercising.

Curb—A curb is found just below the hock and to the rear. It is a thickening of the ligaments or tendons in that region. By looking at the leg from the side it may be easily seen as it is a variation from the straight line which normally extends from the point of the hock to the fetlock. Narrow tied-in hocks are more subject to curbs than those that are broad.



The photo (left) shows a mare standing incorrectly being wide at the hocks and narrow at the ground—base narrow. This is only a faulty conformation but frequently results in unsoundness. Compare this with the photo (right) showing the mare standing with the hocks well under.

Bog Spavin—Bog spavin is found in the natural depression that occurs in the inner and front part of the hock. The oil from the joint accumulates and forms a large swelling commonly known as bog spavin. It is usually associated with a short round hock.

Ring Bones—These are located on the pasterns and are more common to the fore limb. Short upright pasterns are predisposed to ring bone

formation. Pasterns that are too straight on young mature horses usually become more upright with advancing age and the action depreciates in proportion. There are two forms called the high and low ring bone; depending on the location. Usually, it is situated at the hoof head where the foot joins the pastern. Because of the prominence, in most cases, it may readily be seen but occasionally, it is necessary to pass the hand over the joint to detect a small form.



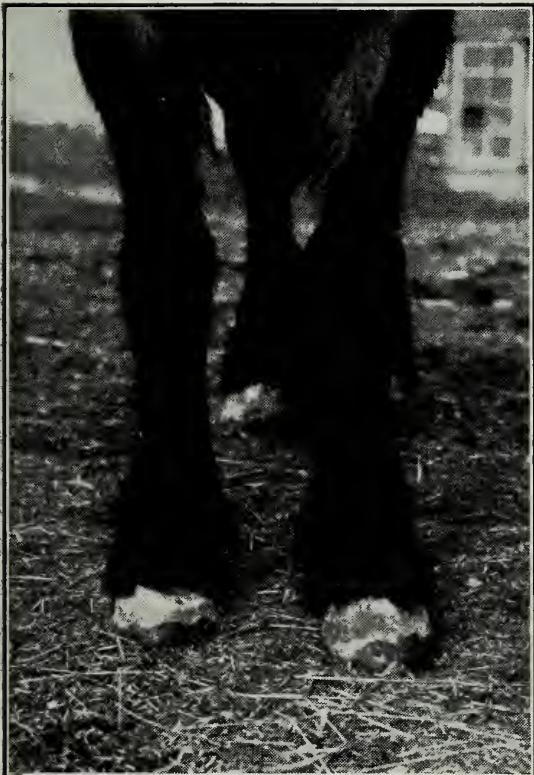
The photo (left) shows an undesirable pair of front feet with four well developed side bones, and (right), clean cut sloping pasterns and broad spreading feet. Note the coarseness and lack of quality of the feet and legs of the former.

String Halt—This is a spasmodic jerking up of one or both hind legs. It is most evident when a horse is walking, turning in a small circle or backing.

Side Bones—Side bones are common to the front feet. By pressing the thumb and fore finger around the hind quarter of the front foot this unsoundness may be detected. They are small, hard prominences that were originally cartilages but have hardened, often causing pain and lameness when the horse is driven on hard roads. They are more common on the outer corners of the heels of wide fronted draft horses because the weight is not distributed evenly on the foot.



The photo (left) shows weakly supported hocks predisposed to curbs and other unsoundnesses. The hind legs of this horse indicate a lack of strength. Contrast this with a normal pair of hind legs (right).

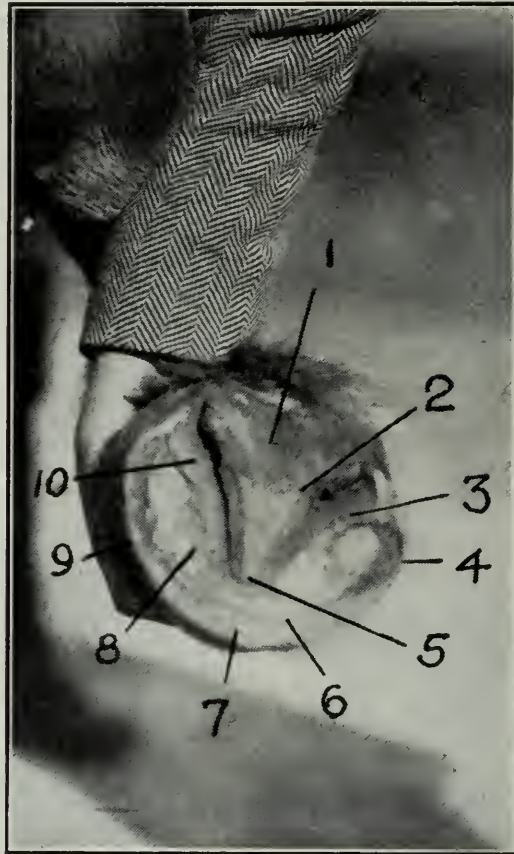


The photo (left) shows the front feet of a horse affected with navicular disease. They have a narrow contracted appearance. The bottom of the foot (right) of the same horse shows a narrow contracted heel and a shrunk frog.

Some horses have coarser cartilages which are soft and pliable and should be distinguished from side bones.

A photo of the bottom of a healthy foot. Note the clear outline of the parts in direct contrast with the diseased foot. The foot has a better shape, a wider heel and a larger frog.

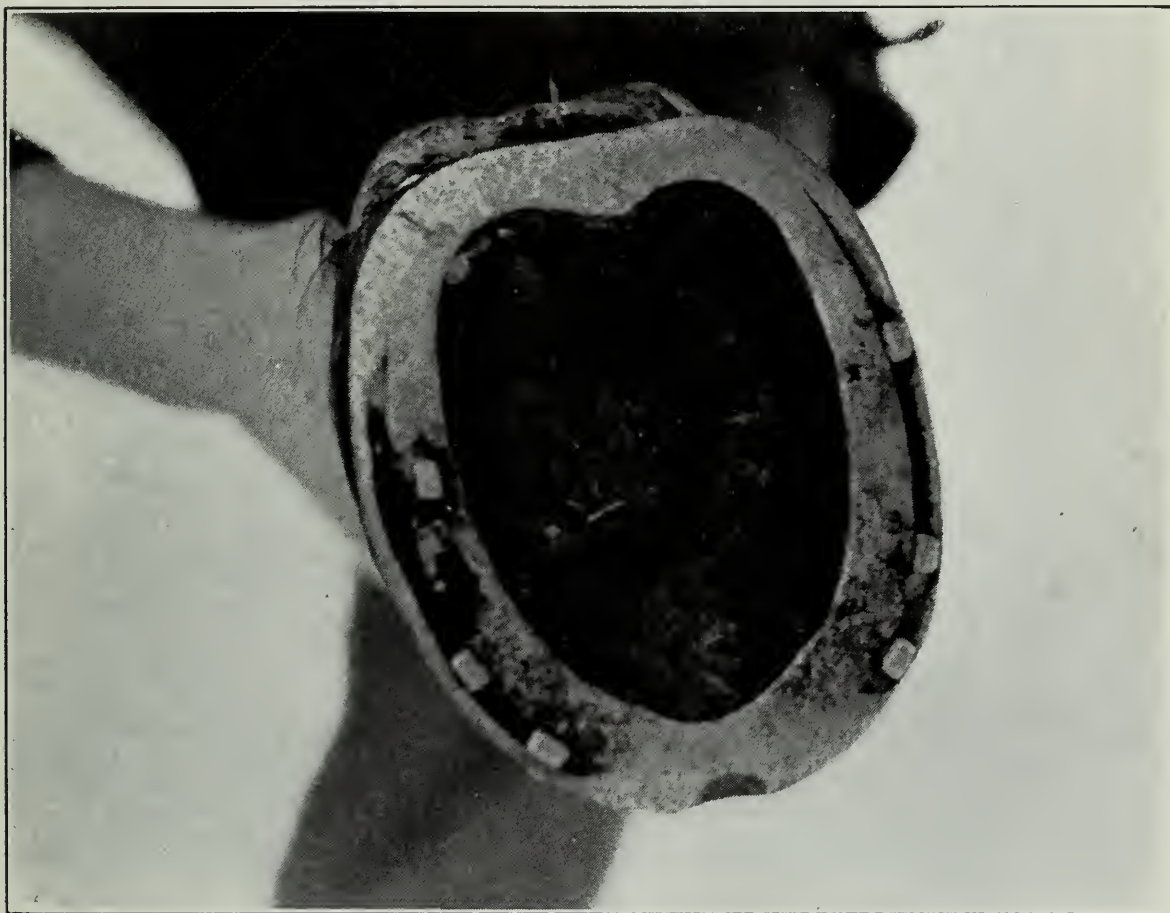
- | | |
|---------------------------|---|
| 1. Central Furrow. | 6. White Line. |
| 2. Lateral Ridge of frog. | 7. Ground Border of Wall of Toe. |
| 3. Bar. | 8. Sole. |
| 4. Outer Quarter. | 9. Inner Quarter. |
| 5. Apex of Frog. | 10. Lateral Furrow between Frog and Toe |



Roaring or Whistling—The chief symptom is a roaring or whistling sound following a brisk trot or heavy work. This sound in severe cases may be heard some distance away. It is one of the diseases which prevents a stallion from standing for public service in France.

Periodic Ophthalmia—This disease is characterized by periodically occurring attacks of inflammation of the eye. Finally the animal becomes blind. The natural shape of the pupil of the eye is elliptical and a horse that has been attacked with this disease usually has a somewhat spherical pupil. Also, the eyelid may be shrunk. A horse by its action will usually indicate if the eyesight is good. Stepping inordinately high or an inclination to shy usually indicates defective vision. By moving the

hand slowly in front of the eye, blindness may be detected. If the hand be moved too rapidly the influence of the air on the eye may induce the horse to shut it though it may not have seen the motion of the hand. Periodic ophthalmia is frequently referred to as moon blindness.



Illustrating the method of shoeing to help a foundered horse. Underneath this particular shoe a leather has been nailed. Shoeing will do much to help the condition but founder can not be cured.

Navicular Disease—In advanced cases the heels contract, the hoof becomes hard and dry, the frog dries up and in bringing the foot to the ground the toe strikes the ground first. At first the symptoms are scarcely noticeable. Without warning the horse may limp but after a few steps goes sound. According to some authorities navicular disease occurs almost exclusively in harness horses.

HOW TO SELECT A SOUND HORSE

In addition to the points already mentioned there are a number of points to take into consideration in the selection of a sound horse.

1. Has the horse any stable vices, such as cribbing?
Are the teeth and jaws a normal shape?

2. Is the horse a grunter? Take the lead strap in one hand and using a stick or cane make a false pass at the horse. It is generally believed a horse that grunts will go bad in the wind.

3. Is the horse affected with heaves?

This can usually be determined by peculiar flank movements caused by a normal inspiration (breathing in) and a double expiration (breathing out).

4. Can the horse back up properly? Are the stifles right?

5. Are the front feet sound? Two-thirds of the weight is carried on the front feet. Do the feet show any signs of founder? Ridges on the hoof that tend to come to a point at the front of the foot are usually an indication of founder.

If in doubt as to the soundness of a horse secure the services of a qualified veterinarian.

The temperament of the horse should not be overlooked.



Illustrating the appearance of the feet on a foundered horse. Notice the peculiar turned-up condition of the toes.



The bottom of the foot of a foundered horse. Note that the sole of the foot is almost level with the bottom of the frog. This is frequently referred to as a drop sole.

ESTIMATING THE AGE

The economic value of the horse depends to a great extent on his age, and it is useful to know how to determine this in order to estimate his worth.

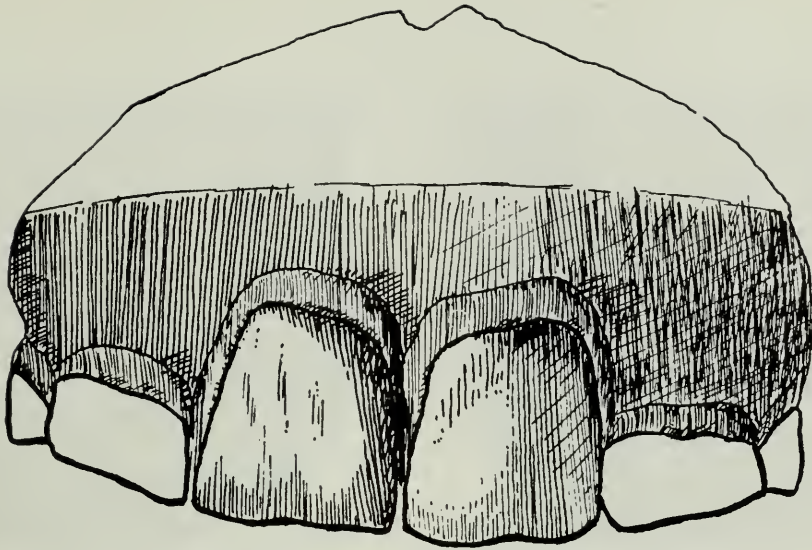
The general appearance of the horse usually gives some indication of age. That is, at a glance, it is possible to distinguish between a colt, a young and an aged horse.



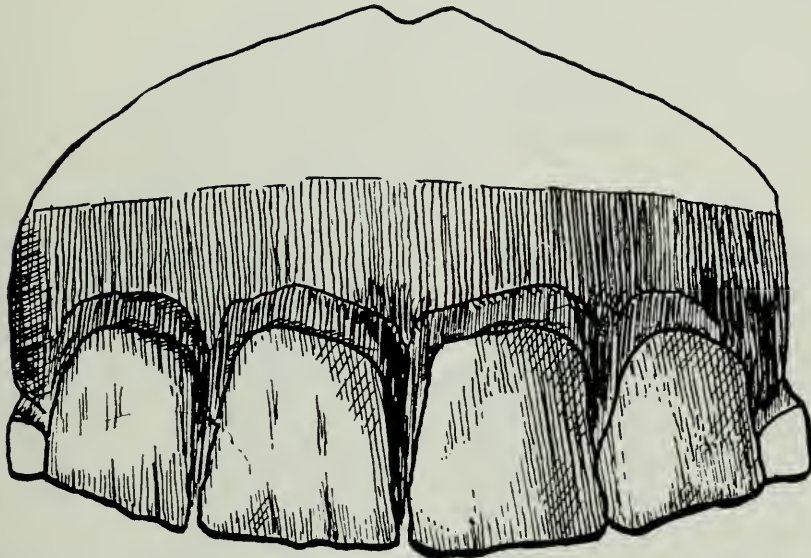
Photo showing the teeth of a horse that cribs. Note the broken appearance on the outer part of the teeth.

The teeth are also a fair indication of the age. The indications become fairly satisfactory to those who have proved them many times by personal observations and in noting differences that exist. It must be remembered that feeds have a marked influence on the wear of the teeth, and make differences not entirely due to age. Pasturing on sandy soils may also cause the teeth to wear more rapidly than when horses are pastured on other types of soil. Liberal feeding favours early maturity and may hasten the arrival of the incisors but usually not more than six months.

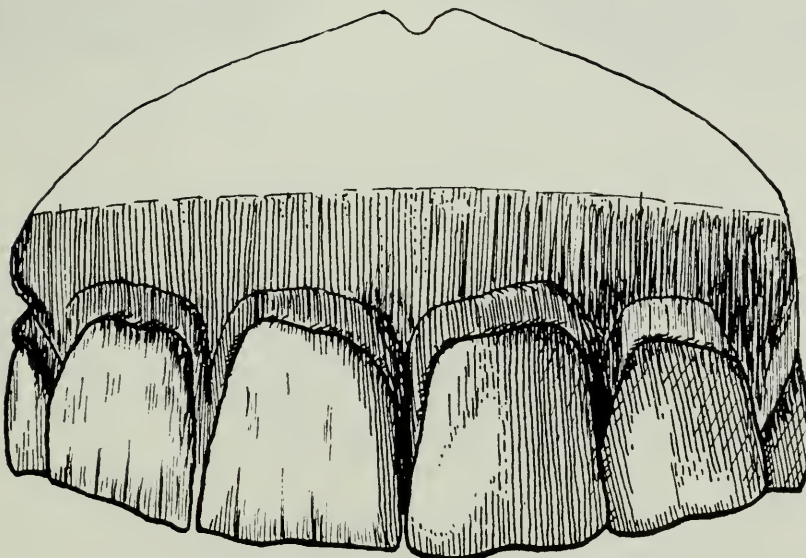
Order of Appearance of Incisors—It is important in estimating the age of a horse to know the difference between temporary and permanent



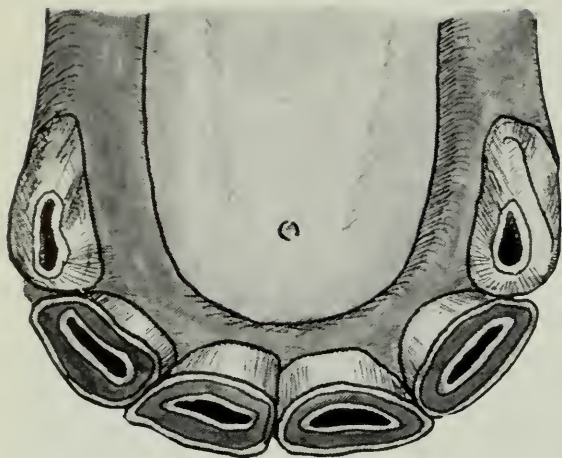
Three-year-old mouth showing first pair (centrals) of permanent incisors.



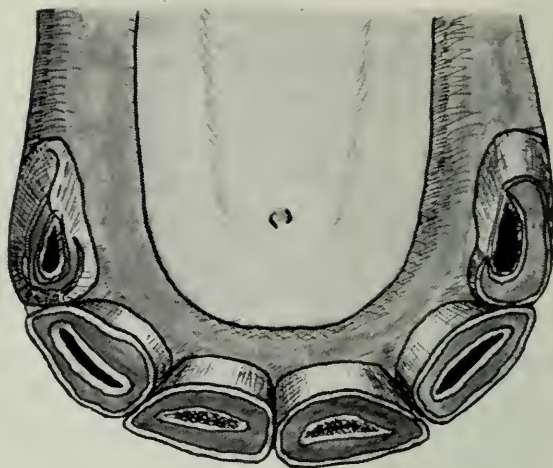
Four-year-old mouth. The second pair (laterals) of permanent incisors are in place.



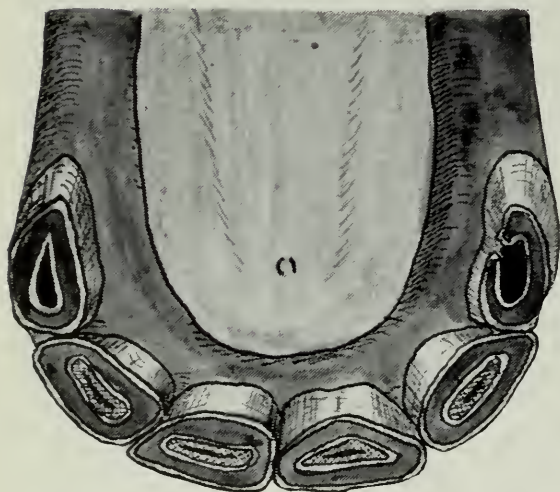
Five-year-old mouth. The horse has now a full mouth, or all his permanent incisors. The corners are in place.



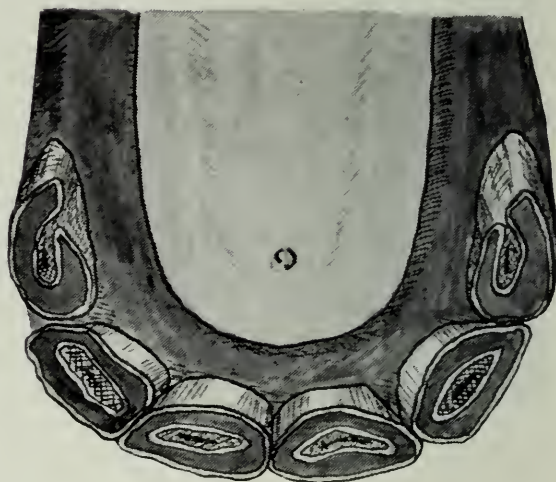
*Five Years
Lower Jaw*



*Six Years
Lower Jaw*



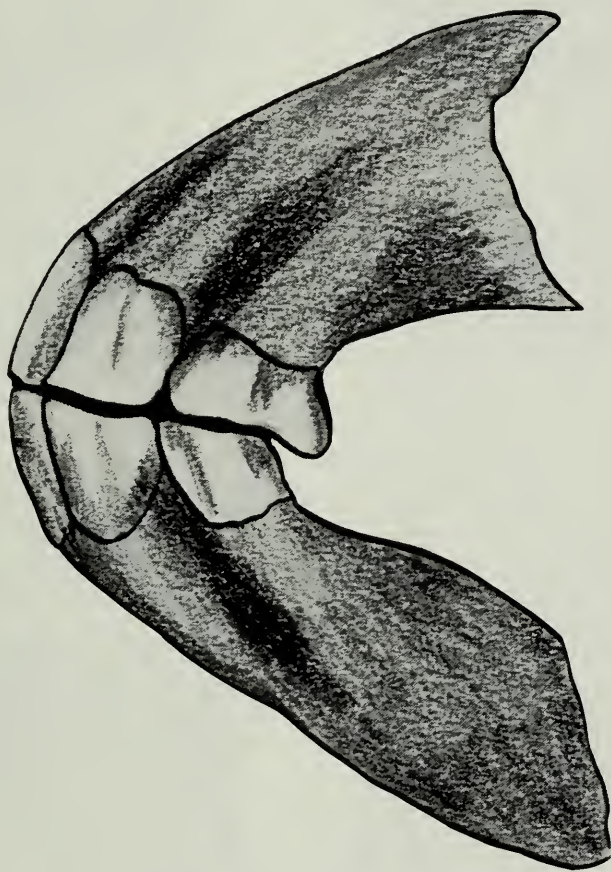
*Seven Years
Lower Jaw*



*Eight Years
Lower Jaw*

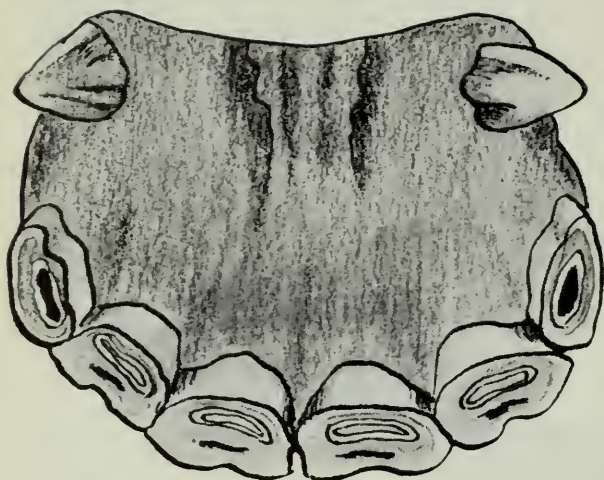
At five years the marks are quite distinct and the tables show practically no wear in any of the incisors. At six years the tables in the centre pair of the lower jaw show some wear, the marks becoming smaller. At seven years the second pair have nearly lost their marks, and at eight the corner pair show considerable wear.

incisors. In the majority of cases the foal at birth has no teeth but it is not long before the temporary teeth begin to appear. The first pair usually appear at about ten days, the second pair toward the thirtieth day, and the corners at six to ten months. The temporary incisors or milk teeth as they are often called, are slender, narrow and very white, while the permanent incisors are broader, thicker and usually of a light yellowish or straw colour. In a general way the replacing of a temporary incisor by a permanent one lasts six months.



Jaws of a seven-year-old mare viewed from one side. These jaws show the indentation of the upper corner tooth, called the dove-tail or seven-year-old hook.

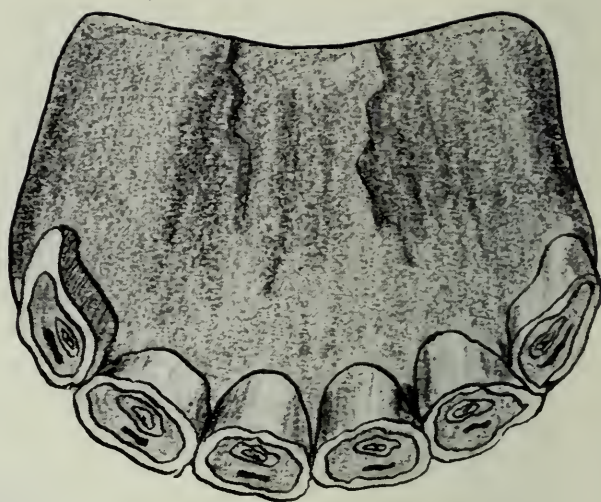
The permanent incisors of the upper and the lower jaw appear at the same time. There are six permanent incisors in each jaw in the full mouth and these make their appearance in pairs. The centrals are the first to appear and have displaced the temporary pair and are full grown when the colt is from two and one-half to three years old. The laterals (second pair) are fully grown at three and one-half to four years, and the corners have displaced the two corner temporary incisors at about five years of age. The horse is then said to have a full mouth.



Nine Years, Lower Jaw

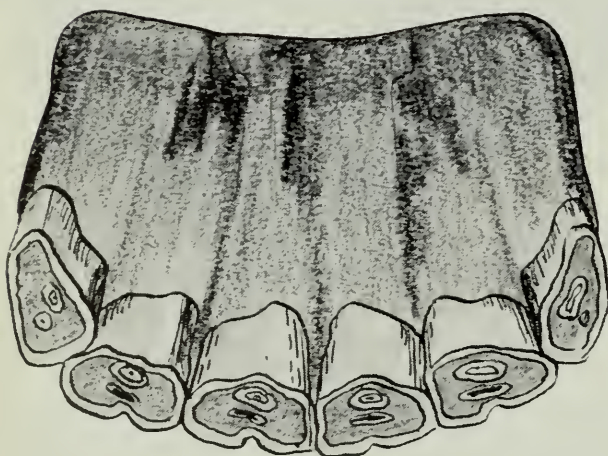
Lower jaw of a horse nine years of age. The central enamel is contracted and approaches the inner edge on all the teeth. The dental star is quite visible on the centrals and laterals. The centrals are rounded.

Note the tushes or canines. These are found in the male animal's mouth and are usually well developed at five years of age.



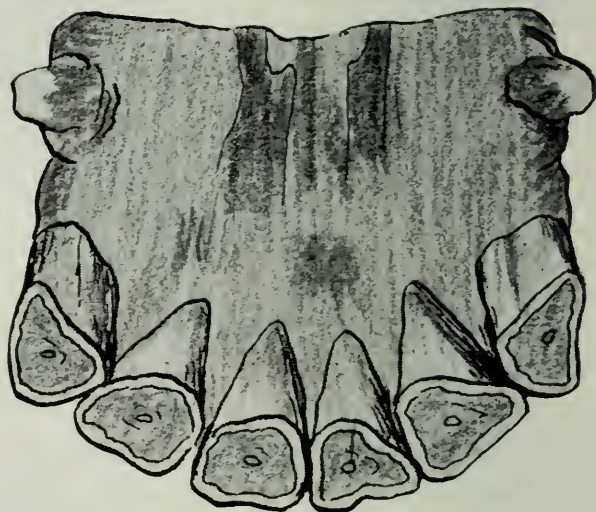
Ten Years, Lower Jaw

Lower jaw of a horse ten years of age. The centrals are well rounded, the laterals begin to get round. The corners are still oval. The central enamel in all incisors is close to the interior edge of the tooth. The dental star is quite visible on all incisors and tends to take a more central position in the centrals and laterals.



Eleven Years, Lower Jaw

Lower jaw of a horse eleven to twelve years old. The corner teeth tend to become rounded. The central enamel is reduced on all the teeth. The dental star becomes plainly central.



Seventeen Years, Lower Jaw

The lower jaw of a horse about seventeen years old. Note the length of the teeth and the shape.

The tushes, canine or bridle teeth usually start to appear at four years. These are commonly found in males though mares occasionally have rudimentary tushes. They are usually situated nearer the incisors in the lower jaw than in the upper. There are two on each jaw.

The permanent teeth grow about one-eighth of an inch each year. This takes care of the wear which, under normal conditions, is not quite one-eighth on an inch. Consequently, the teeth become very slightly longer with advancing age.



Five Years



Seventeen Years

Comparison of a five-year-old mouth with that of a seventeen-year-old, showing the difference in shape as age advances. The teeth spring from the jaw with a much greater slope.

Disappearance of the Cups—The best indications of age from five to eight years is the order of the disappearance of the tables or cups on the incisors. At five years the cups in the centrals of the lower jaw show some wear but it is not until the horse is about six years old that they have almost disappeared. The tushes are usually well developed, and are permanent features of the male animal's mouth; their points are sharp.

At seven years the laterals lose almost all traces of their tables through wear and the corners have a well marked dental table. The upper corner tooth shows the "dove-tail" or "7-year-old-hook" as it is sometimes called.

At eight years the corners are almost free from any appearance of tables. All the incisors are worn. The shape of the incisors are clearly oval. If the tables of the centrals are carefully examined, a brownish, or yellowish brown linear streak will be seen running across the tooth between the inner and outer rings of enamel. This is called the "dental star" and though it may be found in all six incisor teeth at eight years it is usually confined to the centrals or to these and the laterals. The "7-year-old-hook" has worn out from the upper corner teeth or is almost gone. Occasionally, it reappears at nine or ten years.

From nine years of age on it is much more difficult to tell the exact age. At nine years the central and lateral teeth are more triangular, with the inside angle rounded. The cavity has disappeared from the corner teeth and these as well as the centrals and laterals show a fairly definite dental star.

At ten years there is left only a smaller ring of enamel almost circular in outline. The dental star is distinct on all the lower incisor teeth and occupies a more central position.

"Galvayne's groove" appears at ten years. It is seen as a groove just protruding under the gum on the outer surface of each of the upper corner teeth. This groove appears at ten years, has grown about half-way down the tooth at fifteen or sixteen years, reaches the free edge of each tooth at about twenty-one years and by twenty-five years has started to disappear, the upper part of the tooth becoming once more smooth. By about thirty years the groove has disappeared.

After a horse reaches eleven years of age it is even more difficult to tell the age with any degree of certainty. The dental star becomes plainly central. With advancing age, the upper surface of the incisors appear more triangular and the teeth spring from the jaw with a greater slope.

DEFINITIONS OF COMMON TERMS

Horse—Is often used to describe the whole species without reference to sex, but in writing a description it is applied to uncastrated males, and is synonymous with "stallion" or "entire". The latter word is probably most frequently used in writing descriptions.

Gelding—(Often written "geld"). Means a castrated male horse of any age.

Colt—A young immature male horse usually over one year old. The term colts is loosely used to mean geldings and fillies up to three years old.

Colt Foal—A male foal of under one year.

Filly—A young immature female horse usually over one year old.

Filly Foal—A female foal of under one year.

Mare—An adult female horse.

A **Yeld** mare is simply a dry mare four years of age or over. She need not necessarily have ever raised a foal or she may have shown in the brood mare class in former years.

A **Brood** mare is usually required to show with her foal by her side, except at the winter fairs. In the Pure Bred classes the prize list usually states "Brood mare with her foal of the same breed by her side".

Mare with Foal at Foot—Dam and foal running together.

Yearling—A horse of over one year and under two years, e.g., "a yearling colt" or "a yearling filly".

An **Aged Horse**—Correctly speaking, means a horse over eight years, but the term is commonly used to indicate an old horse.

Rig, Ridgling, or Cryptorchid—A male horse of twelve months or over in which one testicle has been retained in the abdomen. (Testes normally descend into the scrotum before eleven to twelve months of age). Rigs are often more intractable than stallions.

Double Rig—As above, but with both testicles retained in the abdomen.

Cob—A short-legged, stocky, rather small horse.

COLOURS AND MARKINGS OF HORSES

Breed has a great effect on colour which is most marked where selection has been practised, viz., the Cleveland Bay, the chestnut of the Suffolk and the cream of the Hanoverian.

Colour is the most conspicuous feature by which a horse can be described or identified, so that a comprehensive colour standard is important. Colours may be generally classed as solid or broken, distinguished by the presence or absence of white spots. Solid colours are further differentiated as hard or soft. A hard colour is one that changes very little with advancing age or with the season.

In the registration of horses care should be taken to have the pedigree description correspond with the colour markings of the horse. The following order of examination might be followed:

1. Colour—If white hairs are found on the body coat these should be noted for example black with white hairs.
2. Marks on head (including eyes).
3. Marks on limbs commencing from the feet up.
4. Marks on body.
5. Remarks on mane and tail—the presence of white hairs on the mane and tail should be noted.



Star

Star & Stripe

Stripe

Blaze

White face & Muzzle

Black—Where black pigment is general throughout the body coat, limbs, mane and tail, with no pattern factor present other than white markings. It varies according to the condition of the horse, e.g., when in poor condition it becomes “rusty”.

Black-Brown—Where the predominating colour is black, with muzzle and sometimes flanks brown or tan.

Brown—A mixture of hairs in the body coat; some of which are black and some a light chocolate colour, with muzzle and underline brown or tan.

Brown-Bay—The predominating colour is brown, with bay muzzle, and perhaps bay on the underline.

Bay—Varies considerably from reddish brown to a light chestnut. It can be distinguished from chestnut by the fact that it entails a black mane and tail, and almost invariably has black on the limbs. It includes bright bay, dark bay, light bay and mealy bay.

Chestnut—Includes bright, golden, and red chestnut, also dark or liver chestnut. The mane and tail are sorrel or chestnut colour.

Grey—Many variations, all tending to become lighter in old age. In this colour, distinctive hoof markings should be noted.

Iron Grey or Blue Grey—Body black or black-brown with an admixture of white hair which gives a grey tinge to the coat. The limbs from the knee and hock downward are usually black.

Bay or Red Roan—Body bay or bay-brown with white hairs giving a reddish tinge to the coat. The limbs from the knee and hock downward are usually dark.

Strawberry or Chestnut Roan—Body chestnut with white hairs. The limbs are not black.

Odd Colours (not used in pedigree descriptions):

Piebald—Where the body coat consists of large irregular patches of black and white. The line of demarcation between the two colours is generally well defined.

Skewald—Where the body coat consists of large irregular patches of white and of a definite colour except black. The line of demarcation between the colours is generally well defined.

Dun—Has two varieties:--

Blue dun with black evenly distributed over the body giving a bluish colour. It may have a dorsal band (list) and wither stripes. The skin, mane and tail are always black.

Yellow dun—Where there is a diffuse yellow pigment in the hair with or without dorsal band, wither stripes or bars on the legs. If there be striping, the head and limbs will be dark, if absent the limbs will be the same colour as the body. The skin is black.

Cream—Body cream-coloured and skin unpigmented. The eye is often deficient or devoid of pigment ("wall-eyed").

LIMBS

White Coronet—Where the hair immediately above the hoof is white. The situation of the white marking is to be described as far as possible.

White Heel—For the purpose of description the term "heel" means the back of the pastern. Where the white is confined to one or both bulbs of the heel, it must be so specified.

White Pastern—For descriptive purposes, “pastern” means the region immediately below the fetlock downwards. Any variation of the extent of the white should be specified, e.g., “half pastern”, “three-quarter pastern”.

White Fetlock—For descriptive purposes “fetlock” means the region of the fetlock joint and downwards. Any variation of extent should be specified.

White markings extending higher than the above should be accurately stated, and any variation in the upper margin noted, e.g., “white to middle of cannon or shank”, “white to knee or hock”.



A wall-eye.

HEAD

Star—Any white mark on the forehead. Size, shape, intensity, position and coloured markings on the white should be specified.

N.B.—The term “white star” is wrong.

Stripe—A narrow white marking down the face, not wider than the flat anterior surface of the nasal bones. It may be a continuation of the star or distinct from it and would in the latter case be described as “interrupted stripe” and “star and stripe conjoined” in the former. Where no star is present, the origin of the stripe should be defined. The termination

of the stripe and any variation in breadth, length, direction, and coloured markings on the white should be described, e.g., "broad stripe", "narrow stripe".

Blaze—A white marking covering almost the whole of the forehead between the eyes, and extending down the front of the face, involving the whole width of the nasal bones. Any variation in direction, termination, and coloured markings on the white should be described.

White Face—Where the white covers the forehead and front of the face, extending laterally towards the mouth. The extension of white may be on one or both sides, in which case it should be described accordingly.

Snip—An isolated white marking; independent of those already named, and situated between, or in the region of the nostrils. Its position should be specified.

Lip Markings—Should be accurately described, whether covering the whole or a portion of either lip.

White Muzzle—Where the white covers both lips and extends to the region of the nostrils.

Wall-eye—This term should be used exclusively where there is such a lack of pigment in the iris as usually to give a greyish-white or bluish-white appearance to the eye. Any other important variation from the normal colour of the iris should be noted.

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BULLETIN 403

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Ontario Department of Agriculture

Statistics and Publication Branch

TORONTO — ONTARIO

IMPORTANT FRUIT TREE DISEASES OF ONTARIO

by

J. E. Howitt, Professor of Botany

and

R. E. Stone, Associate Professor of Botany

ONTARIO AGRICULTURAL COLLEGE
GUELPH — ONTARIO

The object of this bulletin is to furnish all who are interested in fruit growing with information which will enable them to identify the more common diseases of fruit trees and to apply successfully the treatments which experiments and observations extending over a period of eighteen years have shown to be the most effective in each case.

Important Fruit Tree Diseases of Ontario

by

J. E. Howitt, M.S.A.

and

R. E. Stone, B.Sc., Ph.D.

WHAT FUNGUS DISEASES ARE

The majority of the diseases of fruit trees are fungus diseases. It is important that fruit growers having to deal with them should understand fully the causes of such diseases in order that they may apply intelligently, remedies for their control. Fungus diseases are caused by plants known as fungi. These plants, unlike ordinary flowering plants, have no green colouring matter (chlorophyll), and are unable therefore to manufacture their own food. All their nourishment must be obtained from decaying animal or vegetable remains or from living animals or plants. Those fungi which derive their nourishment from living plants in so doing injure them in various ways and thus give rise to what are known as fungus diseases.

The bodies of fungi which cause plant diseases are usually very simple, consisting of very fine, delicate, thread-like structures (hyphae), some of which become modified and produce reproductive bodies called spores, which may be considered similar to the seeds of flowering plants. Sometimes the fungus threads live upon the surface of the plants and obtain their nourishment by sending down little suckers (haustoria) into the cells below. Most frequently, however, they live within the plants, either in or between the cells. Two kinds of spores are frequently produced — thin-walled summer spores, which spread the organism during the growing season, and thick-walled resting or winter spores, which serve to carry it over the winter. Spores are scattered by various agencies, chief among which are wind, water and insects. On coming in contact with a suitable host plant they send out little threads (germ-tubes), which enter the plant through the breathing pores (stomata) on the leaves, through the skin or through wounds. Once within the plant the little threads grow very rapidly, drawing their nourishment from the cells of the host plant and setting up a diseased condition.

Generally speaking, in combating fungus diseases, methods of prevention only are practicable. Once a fungus is within the plant nothing can be done to destroy it. Spraying with lime-sulphur, Bordeaux mixture or other fungicide is not done to cure but to prevent disease. In other words, the object of spraying is to cover the surface of the leaves, fruits or other parts of the plant with a substance poisonous to the spores of fungi, and in which they cannot grow and penetrate the plant. Spraying, therefore, in order to be effective, must be timely and thorough. The spray mixture must be on the tree before the spores reach it and the surface of the leaves, fruit and other parts of the plant must be completely covered so that there is not the smallest space on which a spore can germinate.

SPRAY MACHINES

Many excellent spray machines are available for the fruit grower, nearly all of which are advertised in the various agricultural magazines of the Province. It is not the duty of the writer to recommend any particular machine. Information regarding the merits of the different makes of spray machines should be obtained by the intending purchaser from fruit growers who have had practical experience with them.

The type of machine required will depend upon the extent of the orchard and the size of the trees to be sprayed. A hand pump barrel sprayer with one line of hose, costing from \$35.00 to \$50.00 will take care of a few dozen trees in a garden or small farm orchard.

A commercial orchard of any size requires a power outfit driven by a gasoline engine. Such spray machines are of various sizes and capable of delivering from 5 to 40 gallons of spray liquid per minute under a pressure of 250 to 800 pounds. A Duplex sprayer with a capacity of 6 to 8 gallons per minute at a pressure of from 350 to 400 pounds per square inch is satisfactory for all but large orchards. Large orchards require spray outfits with triplex pumps which deliver 10 to 40 gallons per minute at a pressure of from 400 to 800 pounds per square inch.

The cost of a Duplex power outfit runs from about \$350.00 to \$700.00, and of a Triplex, from \$650.00 to \$1200.00.

SUGGESTIONS ON EQUIPMENT FOR SPRAYING

In purchasing a spray machine, the acreage of the orchard and the size of the trees should be considered. Timing is all important to success in spraying, so the capacity of the spray machine must be such that the entire orchard can be sprayed in at least three days. Many fruit growers with large orchards use two or more sprayers to ensure successful results. Good spraying can be done only with a good sprayer. It is never economy to purchase an inadequate sprayer because it is cheap. Spraying, when the machine is in good running order, is not a disagreeable job, but spraying with an inadequate machine is disagreeable and exasperating due to engine trouble, leaking hose, or other costly delays.

THE HOSE

Only high quality hose should be used. On all power machines the hose should be the high pressure kind, specially manufactured for the purpose. Good hose couplings are essential since poor ones blow out frequently causing discomfort and delays. If there is only one line of hose it should be about thirty-five feet long. If there are two lines of hose, the one for the man on the tank should be about twenty feet long, and for the man on the ground, forty feet long.

Spray guns and spray rods:—On a hand pump barrel sprayer the only suitable equipment is a rod and nozzles, a bamboo rod six to ten feet long, with two angle disc nozzles on a V.

Power outfits should be equipped with rods, single or double guns, or with a broom or multiple nozzle gun depending upon the pressure the machine is capable of maintaining. If the pump will not maintain more than two hundred pounds pressure with two lines of hose, it is advisable for the man on

the tank to use a single gun and the man on the ground a six to seven foot bamboo pole with two angle disc nozzles. Large powerful sprayers capable of maintaining high pressure should be equipped with double guns or with multiple nozzle guns or brooms with four to eight nozzles. Some fruit growers with high power sprayers get good results with one eight nozzle multiple spray gun or broom.

SOME SUGGESTIONS ON SPRAYING

Endeavour to obtain from spraying the maximum control of fungus and insect pests, in the most economical way, with the minimum amount of spray injury. This can be accomplished by keeping in mind the essentials of successful spraying which are: accurate timing, thorough spraying and the use of the best available spray mixtures.

Accurate timing is essential for success. The best spray materials may be used and thoroughly applied, but if not at the right time, and the fruit and foliage are left unprotected for a day or two in wet weather, they are almost sure to be infected by fungi which cause diseases such as apple scab, brown rot of stone fruits, etc. Growers are urged to obtain each year the latest Ontario Spray Calendars, and to time their sprays for each kind of fruit, as nearly as possible according to the directions given in them. The times recommended in the Spray Calendars are as nearly right as our knowledge can make them, and if each spraying is given at the time indicated, it will almost always give protection until the next one is due.

Thoroughness is extremely important for success. It means covering every leaf and fruit on all sides. On large trees this is not easily done and requires much care and systematic work. Remember it is always the side of the fruit that is most shaded, the side towards the centre of the tree, that is most likely to be attacked by disease. Hence, in spraying from each side, see that the spray goes right through the tree to the other side. The top of the tree is another part which is likely to be poorly sprayed, so hold the spray a little longer on the tops of the trees than on the lower parts, and see that it goes over the top and falls down on the other side. When the trees are tall, a tower should be built on the top of the tank.

When possible, take advantage of the wind, and spray with it. Sometimes after the orchard has been sprayed from one side, threatening rain makes it necessary to spray from the other side before the wind changes if protection is to be secured. In such cases, it is often possible to spray early in the morning or after supper when the wind is down. When this can not be done, the spraying can usually be done fairly well by driving straight into the wind and spraying at right angles to it from one side. Then come back again and go up on the other side of the trees against the wind, and shoot the spray at right angles from this side also. This means spraying the trees from three sides and using more material than would have been required if it had been possible to spray both sides with the wind. In order to thoroughly spray a tree, remember it is necessary to spray it from both sides. It is impossible to cover the fruit in any other way.

The spray mixtures recommended in this bulletin and in the Ontario Spray Calendars are what we consider the best available. Carefully conducted experiments and the experience of fruit growers have shown that these give the best control of fungus and insect pests with the least spray injury at a reasonable cost.

FILLING THE TANK

Much valuable time is often lost in filling the tank. A water system which permits rapid filling should be installed near the orchard. It should be possible to fill the tank in five or ten minutes. When it takes twenty minutes or half an hour for this operation, much valuable time is lost. The best equipment for filling the tank is an elevated reservoir from which the spray tank can be filled rapidly through a hose or pipe, two inches or more in diameter. The reservoir may be filled as often as necessary by means of a force pump or rotary pump driven by a gasoline engine, or in some cases, by a windmill. Many spray outfits are now provided with a special arrangement which permits refilling the tank by suction. These are slower but satisfactory if the water supply is close at hand.

CARE OF THE SPRAY MACHINE

Long and efficient service from a spray machine depends upon good care at all times. During the spraying season oiling and greasing of the pump and motor should not be neglected, and care should be taken to immediately tighten up any nuts and parts that become loose. If the machine is to stand idle for a day or more, the tank should be drained and washed out and clean water pumped through the nozzles. The machine, when idle, should be kept under cover, not left exposed to the sun and rain. At the end of the season all the equipment must be washed thoroughly. The hose and nozzles, after being cleaned by pumping water through them, should be drained and put away in a dry place. Guns should be oiled before they are put away. The pump should be filled with oil and all parts which are apt to rust, cleaned and greased. The water should be drained out of the engine pipes and other places where, if left, it might do damage by freezing. In the spring a month or more before spraying is likely to start, the whole spray outfit should be carefully overhauled and tested to be sure that there will be no costly delays in starting the spraying.

SPRAY CALENDARS

Two spray calendars, one for apples and the other for pears and tender fruits, have been prepared by the entomologists and plant pathologists of the Province and Dominion acting in co-operation. These calendars are revised annually and thus are always kept up-to-date. They tell the time to make each application, the mixture to use, the right strength of each and the number of applications necessary. No grower can afford to do without these calendars. Be sure to get the new ones each year.

DUSTING VERSUS SPRAYING

Dusting trees with a fungicide and an insecticide to control diseases and insects is a much more rapid and easy method than spraying. Experiments and the results obtained by various fruit growers have demonstrated that dusting is not nearly so reliable a method as spraying, especially in a season very favourable for the development of apple scab. There are also several insects, such as, the fruit tree leaf rollers, red mite and certain scale insects which the dust does not control. Hence, if only one kind of outfit is to be used in the



Dusting fruit trees for insects and diseases. (Original.)

orchard it should in most cases be a sprayer and not a duster. A duster, however, is very convenient and desirable for a man with a large orchard to help him out in an emergency and to use in making late applications wherever such are necessary. If a late application is given with a sprayer it stains the fruit but with a duster, especially if the sulphur dust is used, it does not.

APPLE SCAB, (*Venturia inaequalis* (Cke.) Wint.)

This is the most common and most serious disease of apples in Ontario. It occurs wherever apples are grown and the scab spots on the fruit and leaves are familiar to almost every fruit grower. It is the chief disease that the grower has in mind when he is doing his spraying. In wet seasons scab causes a loss of many thousands of dollars to the fruit growers of the Province. This is to a large extent a needless loss, for apple scab can be prevented, no matter how wet the season may be, by timely, thorough and intelligent spraying. Such spraying, however, can be done only when the fruit grower understands the nature of the disease and how it is spread, and knows the climatic conditions which favour the spread and development of the fungus which causes it. Such knowledge is invaluable in the control of apple scab. It makes clear the necessity for timely and thorough spraying to insure protection of fruit and foliage from scab infection during the times in the spring and summer that it is most likely to occur.

Symptoms — Apple Scab affects the blossoms, fruit, leaves and rarely the twigs. It is most conspicuous on and does most damage to the fruit and leaves. Scab may appear on the fruit during any stage of its development provided climatic conditions are such as to render possible the spread and growth of the fungus which causes it. Young fruits on which scab spots develop are often stunted and deformed. Mature fruit is rendered unsightly and unsaleable by the conspicuous black and brown scab spots often bordered with a greyish rim. In severe scab there is sometimes a cracking of the fruit, such as is often seen when Pear Scab destroys Flemish Beauty pears. Not only does the scab render the fruit unsightly but it also makes it very liable to shrivel or rot in storage. If scabby apples are packed during moist, warm weather, or kept in a moist condition, a pinkish white mould is very likely to



Apple Scab on fruit. (Original.)

develop around the edges of the spots. This soon causes a rotting which markedly injures the fruit and makes it unpalatable. This is known as Pink Rot. Other rots caused by Blue Moulds (*Penicillium*) and other fungi, also develop around scab spots on apples in storage. Such fruit of course is hard to market and can be sold only at very much reduced prices. In some seasons apples when packed show little or no signs of scab, but when they are examined two or three weeks later small scab spots are found to have developed on them. This is due to the fact that spores of the scab fungus were on the apples when they were packed, and there was sufficient moisture in the barrels for these spores to germinate and infect the packed apples.

On the blossoms scab usually appears first on the tips of the sepals. Sometimes it affects the stems of the blossoms, causing them to drop, thus reducing



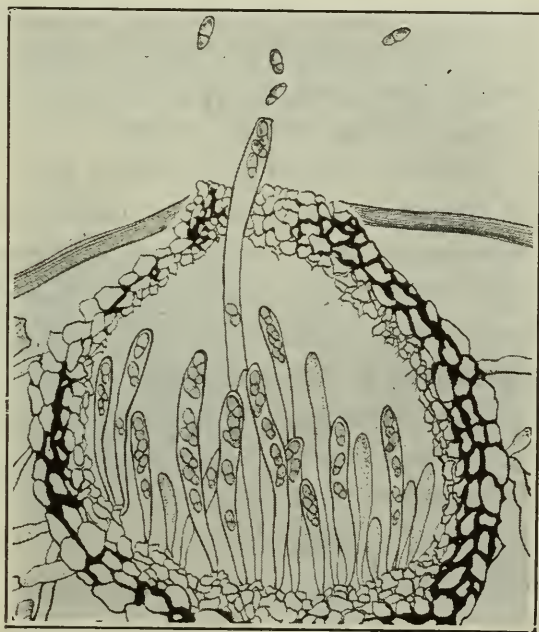
Apple Scab on leaves. (Original.)

very markedly the set of the fruit. Frequently the scab fungus infects the base of the calyx of the blossom, and, as this will become the fleshy part of the apple, such infections result in the young fruits being scabby and often deformed.

On the leaves the scab first appears as small, somewhat circular olive-brown spots which are seen first on the lower surface and later on both surfaces. Under weather conditions favourable to the fungus these increase in size, run into each other and become brown or black so that a considerable portion of the leaf is destroyed. In severe attacks the leaves become crinkled and to some extent curled. Sometimes they fall but most frequently they remain on the tree. The leaves are the food factories of the tree. The food manufactured by them is used for the growth of the fruit, stems and root, and for the formation of fruit buds next year. Hence severe injury to the leaves by scab impairs the vitality of the tree and prevents the normal development of fruit buds, and thus may reduce the crop.

Varieties of apples differ very much in regard to their freedom from scab. It is a great help in controlling scab to know something regarding the susceptibility of the different varieties, as the scab is very much harder to control on varieties which are very susceptible to it than on those which are not. Common varieties of apples which are (a) very subject to scab — Snow, McIntosh, Melba, Gravenstein, Early Harvest, Stark, Baxter and St. Lawrence; (b) moderately subject to scab — Spy, Rhode Island Greening, King, Baldwin and Ben Davis; (c) slightly subject to scab — Duchess, Blenheim, Yellow Transparent, Tolman and Golden Russet.

Life History — The fungus which causes scab passes the winter chiefly in the fallen leaves beneath the trees. If these are examined in the early spring small black points will be seen projecting from the skin on the leaf on one or both sides. They vary in size from a mere speck to a pin head.



Section of Fruiting Body (Perithecium) of the Apple Scab fungus, showing the discharge of the spring spores (ascospores). (After Wallace.)

Each is a fruiting body (perithecium) of the fungus and contains numerous long, sac-like structures (asci), (see illustration), each of which in turn contains eight two-celled spores (ascospores). When mature each fruiting body (perithecium) opens by means of a minute pore through which the spores are shot out from the sacs by a peculiar popgun-like arrangement. Moisture is necessary for the discharge of these spores, which take place chiefly during the spring rains from the time the blossom buds are bursting until the petals are falling. Some of these spores, however, may be discharged much later in the season than this. These spores infect the unfolding leaves and blossoms, and give rise to the first scab spots of the season. Moisture is essential for the discharge of these spores and for their germination and development. When there is plenty of moisture these spores germinate and send out a tiny thread-like structure (germ tube) which penetrates beneath the outer layer of the skin (cuticle) of the leaf or blossom. It has been shown that the leaves must be continuously wet for several hours before this takes place. It is, therefore, only when we have a day or two of rain or heavy fog that the fungus spores are scattered through the orchard and infection takes place.

About ten to eighteen days after the spores from the fallen leaves have infected the leaves or young fruit, the first scab spots of the season are observed. These, if examined with a microscope, are found to be composed chiefly of spores and fungus threads. These spores are produced on little stalks right on the surface of the scab spots, the fungus having developed under and pushed off the outer layer (cuticle) of the fruit or leaf. If the weather is dry and warm they can do no harm as moisture is necessary before they can be scattered freely and germinate, but if a period of wet weather comes the spores on the scab spots are scattered by rain and wind-borne rain, and infect the leaves or fruits and in ten days or two weeks another crop of scab spots is developed. If the weather is wet the spores from these may in turn give rise to more scab spots, so that there may be several successive generations of these spores during a wet season. In seasons of average weather conditions for Ontario, the period when most infection occurs is from the time when the blossom clusters are pushed up in the buds until about two weeks after the petals fall. Infection, however, may occur earlier than this — when the fruit buds are bursting. In some seasons serious infection may also occur later, about the end of June. May and June are nearly always the month in which there is the greatest danger of scab becoming serious. During July and most of August the scab fungus can rarely develop because at this time of the year there is not sufficient continuous moisture as prolonged wet periods seldom occur, and the days are long and the nights comparatively short and warm, so that the leaves and fruits are quickly dried even after heavy showers. In August and September, however, prolonged cool wet weather may occur and at this time there is danger of late infection.

Prevention — Apple Scab can be prevented by timely and thorough spraying in combination with proper pruning of the trees. It is all important that spraying should be done at the right times. The spray mixture must be on

the leaves and fruit before the spores reach them. We have already learned that the spores are scattered and develop only during wet weather. The times of the year, therefore, when we get our wet weather are the times we have to spray if we are going to prevent scab. One or two sprayings with either lime sulphur or Bordeaux mixture are not sufficient as the rain gradually washes the spray off, and as the leaves and fruit, by growing larger, develop more surface to cover. In order to be sure of preventing disease one must spray from four to six times during the season, the number of sprayings depending upon whether the weather is wet or dry. Five applications are usually given every year, namely: the first spray, the pre-pink spray, the pink spray, the calyx spray and the first cover or little apple spray. Additional sprays are generally required for the control of apple maggot and sideworm. The object of any spray programme should be to so time the different sprays that there is a film of protection, in the form of a good fungicide, on the foliage and developing fruit from the time the blossom buds are bursting on most varieties until four to six weeks after the calyx spray.

FIRST SPRAY

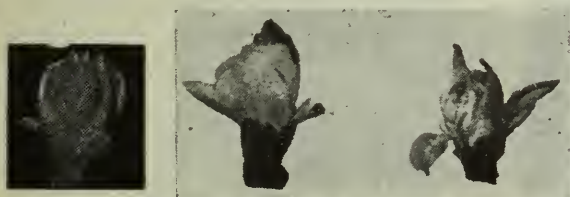


Fig. 1 (a) (b) (c)

In districts where there is no San Jose scale or Oyster Shell scale is not abundant, begin spraying as soon as the buds are bursting on most varieties. (Fig. 1. b & c). Leave Spy until it has reached the right stage. Use Bordeaux 3-6-40 or lime sulphur 1-40.

Bordeaux is much the better at this time.

In districts where San Jose scale is abundant begin spraying as soon as the buds show green at the tip and finish by the time they reach the stage of Fig. 1 (a). Use lubricating oil emulsion 4% in Bordeaux 3-6-40, or use lime sulphur 1-7.

PRE-PINK SPRAY



Fig. 2

This spray should be given as soon as the fruit bud clusters begin to appear on most varieties (Fig. 2). In an orchard containing a mixture of varieties be guided for this application by the development of such varieties as Snow, McIntosh and Wealthy. Use preferably Bordeaux 2-4-40 except on

varieties subject to russetting, such as Baldwin, Ben Davis and Jonathan, and adds $1\frac{1}{2}$ lbs. lead arsenate or 1 lb. calcium arsenate, or use lime sulphur 1-40, 3 lbs. hydrated lime and either $1\frac{1}{2}$ lbs. lead arsenate or 1 lb. calcium arsenate. If lubricating oil is used in the first spray, Bordeaux should be used at this time.

PINK SPRAY



Fig. 3

This should be given when most of the blossoms are showing pink. The ideal time to apply the pink spray is just after the blossom buds have separated (Fig. 3) but in a cool, wet weason it is not safe to wait until this stage is reached. In such a season spray one side of the tree after the blossoms are showing pink but before they separate and spray the other side immediately after they separate. If the blossoms open before this spraying is completed

omit the poison and finish the application. Use preferably a wettable or bentonite sulphur according to the manufacturer's directions and add $\frac{1}{2}$ gallon of lime sulphur and $1\frac{1}{2}$ lbs. of lead arsenate to every 40 gals. of the spray; or use lime sulphur 1-40 and 3 lbs. hydrated lime and either $1\frac{1}{2}$ lbs. lead arsenate or 1 lb. calcium arsenate.

CALYX SPRAY

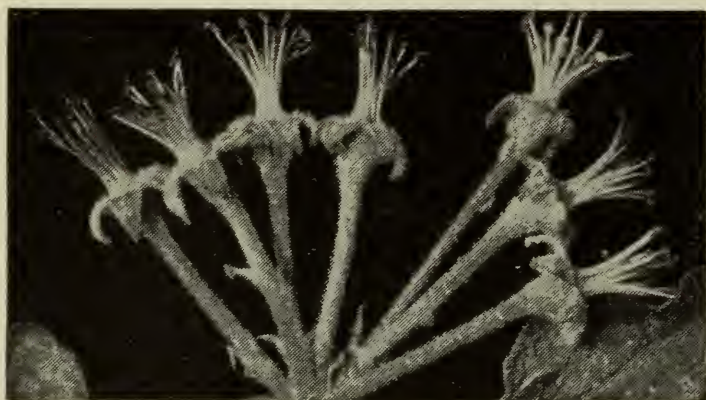


Fig. 4

This should be given immediately after the blossoms have nearly all fallen. This is generally a very important spray in the control of apple scab and always the most important application in the control of codling moth. It must be promptly applied. A delay of a day or two may make all the difference between success and failure. In order to control

the codling moth the calyx cups of the little apples must be filled with poison. This means that the spraying must be very thoroughly done. If the trees are large it is advisable to have a tower or support on the tank in order to do thorough work as it is necessary to reach all parts of the tree, and to have the spray mixture carried through the tree from one side to the other in the form of a fine mist if it is going to reach all the small fruits. Use preferably a wettable or bentonite sulphur according to the manufacturer's directions and add $\frac{1}{2}$ gal. of lime sulphur and $1\frac{1}{2}$ lbs. of lead arsenate to every 40 gals. of the spray; or use lime sulphur 1-50 and $1\frac{1}{2}$ lbs. of lead arsenate.

FIRST COVER (Little Apple) SPRAY

This should be given about twelve days after the calyx spray. Use a wettable, a bentonite, or a ferrox flotation sulphur, according to the manufacturer's directions, or use lime sulphur 1-50 and to either add $1\frac{1}{2}$ lbs. of lead arsenate to 40 gals. Do not spray on a hot, calm day, and apply the spray in the form of a fine mist.

SECOND COVER (First Apple Maggot) SPRAY

This should be applied about four weeks after the blossoms fall. This will usually be the last week in June or the first week in July. Use 2 lbs. of

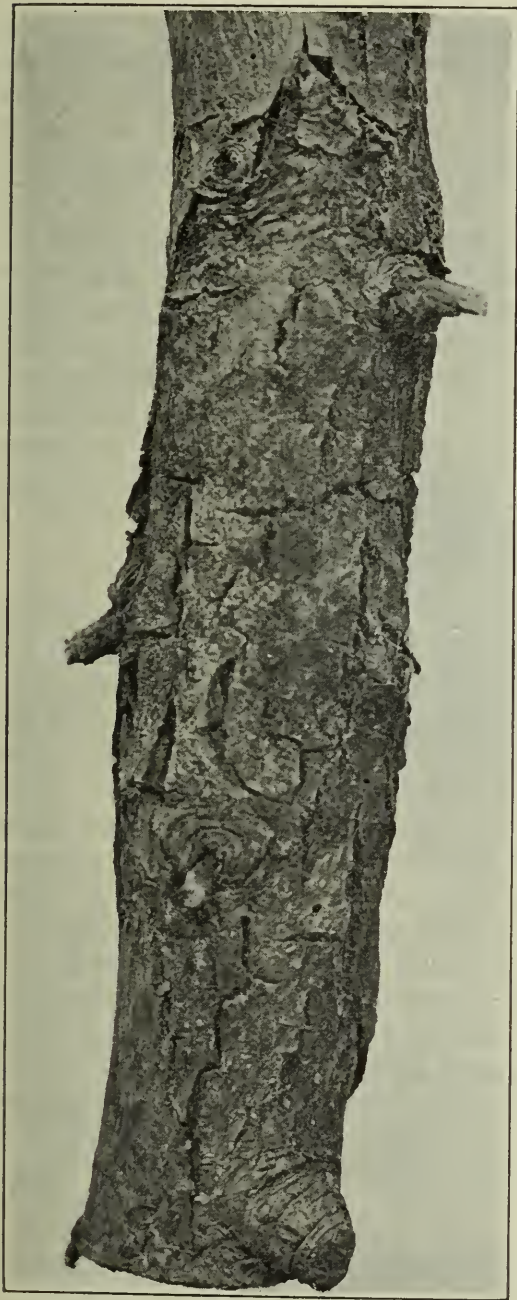
lead arsenate to 40 gals. either of Bordeaux 1-2-40 or of a bentonite or a ferrox flotation sulphur. It is not advisable to use Bordeaux on Ben Davis, Baldwin and Jonathan at this time as these varieties are very subject to russetting.

BLACK ROT CANKER, BLACK ROT AND LEAF SPOT (*Physalospora cydoniae*, Arnaud)

This disease is found in most parts of the Province, and is worst generally in poorly cared for and neglected orchards. In the apple-growing districts east of Toronto it has caused serious injury to apple trees and much alarm to the growers. In that part of the Province, however, it is not by any means confined to neglected orchards. Observations and experiments show that the fungus causing Black Rot Canker is unable to penetrate healthy bark, and can gain entrance and produce cankers only through wounds owing to various causes, such as winter injury, sunscald, carelessness in cultivation, pruning and picking of the fruit. Varieties of apples which are most susceptible to Black Rot Cankers are those which are too tender for the district and so suffer severely from winter injury and sunscald.

The fungus which causes Black Rot Canker is not confined to the apple. It is recorded as affecting pear, quince and other trees, but the writers have not observed it at least to any appreciable extent in Ontario on any host but the apple.

Symptoms — This disease affects the trunk, branches, leaves, fruit and sometimes the twigs. It causes most damage by the cankers produced on the trunk and larger limbs. On the leaves circular spots from one-eighth to one-quarter of an inch in diameter are produced. These are brown in the centre, with a distinct purplish margin. Towards the centre of these spots the minute black fruiting bodies (pycnidia) of the fungus can often be seen by a



Black Rot Canker on branch.
(Original.)

careful observer. The leaves are seldom severely injured by these spots, but frequently they are plentiful enough in unsprayed orchards to attract the attention of the grower.

On the fruit a small brown spot first appears. This gradually increases in size until the whole fruit becomes rotten, brown, and later black. The surface becomes covered with minute black fruiting bodies (pycnidia), which helps to give to the rotted fruit a black appearance. For some time the affected fruits remain firm and retain their normal form, but finally shrivel. These black, shrivelled fruits are frequently seen hanging on the trees or lying on the ground beneath. In Ontario, the rotten fruit in the orchard is not abundant and is seldom noticed by the grower except on Alexanders. In storage also, so far as our observations go, the Black Rot on the fruit attracts but little attention.

On the trunk and larger limbs discoloured areas appear on the bark. These may increase in size, forming large cankers, which with age become cracked, rough and black. These cankers may be only a few inches long, or they may be a yard or more in length. They are usually found on the southwest side of the trunk and on the upper side of the larger limbs, these being the parts of the tree that are most likely to suffer from sunscald and winter injury. In many cases the cankers gradually enlarge, extending completely around the trunk or branch, and penetrating through the bark to the wood, thus girdling the part attacked. The cankers in this way frequently destroy the larger limbs, and, when they occur on the trunks, which they very often do, may cause the death of the whole tree. Sometimes the cankers remain small. Frequently even the larger ones do not penetrate deeply, and cause merely a superficial roughening of the bark, which in time may disappear. Embedded in the bark of the cankers small, black, pimple-like structures may be seen with the naked eye. These are the fruiting bodies (pycnidia) of the fungus.

Life History — The fungus causing this disease is carried over the winter chiefly in the form of dormant fungus threads (mycelium) in the cankers and immature spore cases (pycnidia) which are seen in abundance as little black specks in the skin of the rotted apples, the bark of the cankers and to a less extent in the spots on the leaves. In these spore cases numerous spores (pyncospores) develop which mature and are discharged during the spring and early winter. A second form of spores (ascospores) are sometimes developed in fruiting bodies (perithecia) embedded in the bark of the cankers. It is also probable that some of the spores discharged from the spore cases (pycnidia) in the summer, winter over in the crevices of the bark. As has been stated before, observations and experiments have shown that infection can only take place through wounds in the bark, the spores being unable to infect sound and healthy tissue. Winter injury, sunscald, carelessness in cultivation, pruning and picking of the fruit, or other causes make wounds through which the fungus gains entrance into the bark and finally spreads and causes cankers. Varieties which suffer from winter injury and sunscald are very subject to Black Rot Canker because it is chiefly through such wounds that the fungus gets a start in the healthy bark.

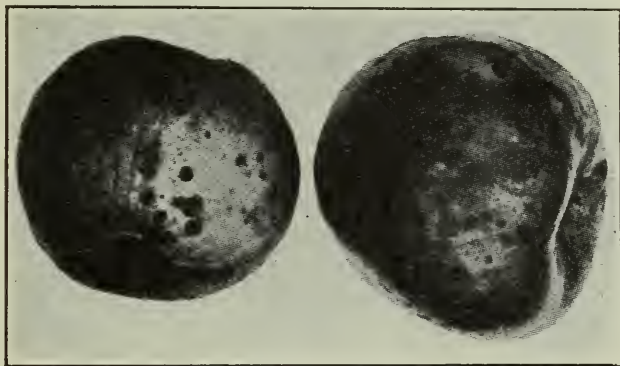
Treatment — Plant only those varieties which are known to be hardy in the district where they are to be grown. The double working of apple trees should prevent much of this trouble in the extremely cold parts of the Province. Keep the trees thrifty by proper pruning and cultivation. In districts subject to extreme cold during the winter months do not cultivate later than the first of June, then sow a cover crop. Such treatment will check the growth of the trees and cause the wood to harden for winter. Cut out all cankers on the trunk and larger limbs, except those that are merely superficial. Use a draw-knife for this purpose and cut back to healthy bark, taking care

to leave the edges of the wound smooth, even and perpendicular. Wash the wounds thoroughly with concentrated lime-sulphur or with bluestone, one pound to ten gallons of water, and paint over with one of the approved asphalt preparations. Badly cankered trees, which would be dead in a year or two if neglected, can in many cases be saved by cutting and treating the cankers as described above. In pruning it is often advisable to cut out and burn large limbs which are badly cankered, if this can be done without causing too much injury to the tree. Sometimes, when it is necessary to remove a badly-cankered main limb, a sucker nearby can be left to grow and take its place. Proper spraying is also of importance in controlling this disease.

Spray the trees as recommended for the prevention of Apple Scab. Give special attention to the first application and take care to see that the trunk and main limbs are thoroughly covered with the spray mixture at this time.

SOOTY BLOTCH (*Gloeodes pomigena*, (Schw.) Colby)

This disease sometimes disfigures apples and by so doing much reduces their market value. Spy and Greening appear to be particularly susceptible to it. It does not usually appear until late summer or early fall, and only becomes prevalent enough to cause serious disfigurement of the fruit when the weather is exceptionally wet at this time of the year.



Sooty Blotch. (Original.)

Symptoms — The disease is easily recognized by the characteristic irregular sooty blotches which the fungus causes upon the fruit. These may be few and scattered or numerous and often coalescing so as to give a sooty appearance to a considerable area of the surface of the apple. Affected fruits are disfigured and rendered unattractive, but the flesh is not injured as the fungus does not penetrate below the skin.

Prevention — Prune the trees to let in plenty of light and air as Sooty Blotch is always worse where the dense foliage keeps the fruit damp for a long time after showers and heavy dew. Spray the trees as recommended for the prevention of Apple Scab. In a very wet fall a late spray the first week in August with a wettable sulphur should do much to prevent this trouble on properly pruned trees.

STIPPEN, BALDWIN SPOT OR BITTER PIT

This disease is not caused by any fungus, bacterium or insect. It appears to be caused by an upset nutritional balance, probably brought about by extreme variations of the water supply to the tree during the growing season.

The conditions tending to the development of Stippen or Bitter Pit appear to be: First, the alteration of extremely dry and wet periods during the growing season; second, an excessive nitrogen supply in the soil; third, soils of poor physical or mechanical condition, especially those lacking sufficient humus, and having a poor water holding capacity; fourth, heavy pruning or a system of pruning which causes the fruit to be produced on the main limbs rather than on well distributed laterals; fifth, trees that produce a light crop of over-size fruit.

Prevention: Until we have more definite information as to the cause of this trouble, no positive statements can be made as to the best way to control it. Growers should adopt those horticultural practices which tend to an even, normal development of the fruit throughout the season. Such practices in-



Stippen or Bitter Pit. (After McAlpine.)

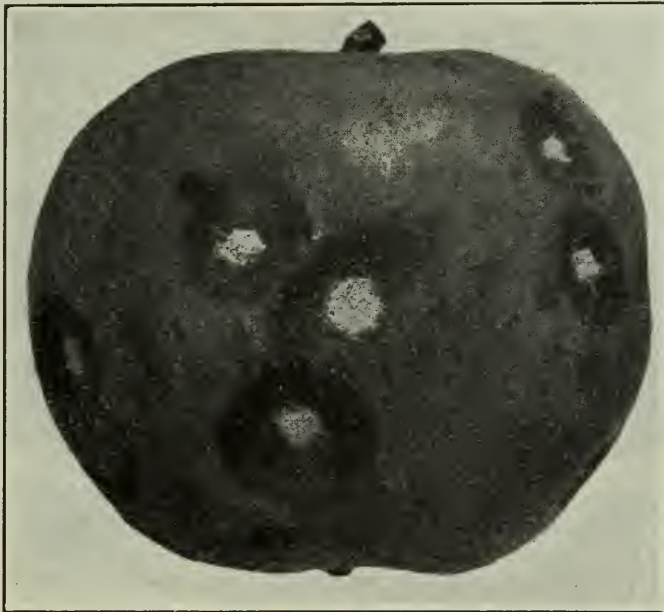


Internal Stippen. (Original.)

clude: first, the increasing of the water holding capacity of the soil by the application of manure or by the use of cover crops, suitable for the locality; second, a fertilizer programme which does not lead to an excessive nitrogen supply in the soil. In orchards in which Stippen or Bitter Pit is giving trouble, it is wise to cut down the nitrogen applications and increase the minerals. Apply a complete fertilizer rather than nitrogen only; third, cultivation or mulching to ensure moisture and equalize the supply throughout the growing season; fourth, pruning, so that a balance is maintained between the root system and the top, and the crop evenly distributed over the tree; fifth, under drainage of the orchard when there is any evidence that it would help the trees.

PINK ROT (*Cephalothecium roseum* Cda.)

Pink Rot is chiefly a storage trouble, succeeding Apple Scab. It is found on scabby apples which have been packed during moist weather or stored in a damp place. The fungus which causes this rot cannot penetrate the sound skin of the apple, and can gain entrance to the flesh only through scab spots or other wounds. Greening and Snow are particularly subject to Pink Rot.



Pink Rot following Apple Scab. (Original.)

Symptoms — A whitish mould sometimes with a distinct pinkish tinge develops around or upon the scab spots. This is followed by a brown rotting around the spots, which markedly disfigures the fruit and renders it unpalatable.

Prevention — Spray thoroughly to prevent Apple Scab. Pink Rot never causes serious injury except to scabby apples. In packing, discard any fruits showing signs of white mould. Store the fruit in a cool dry place as soon after picking as possible. If possible pick and pack when the weather is cool and dry.

PEAR BLIGHT (*Bacillus amylovorus*, Burrill)

This destructive disease is usually known by the above name, but fruit growers speak of it also as Blight, Fire Blight, Twig Blight, Blossom Blight,

and, when it infests the trunk, as Body Blight.

It attacks not only pears, but also apples, crab apples, quince, mountain ash, hawthorn and juneberry. The last three are rarely much affected, but pears, apples, crabs and quince suffer severely in seasons favourable for the development of the organism. So destructive is the Blight to pears that many good orchards have been almost totally destroyed by it; in fact, so great has been the loss that in many districts fruit growers have given up pear growing in the belief that they cannot successfully cope with the disease. Apples do not suffer so severely as pears, yet some varieties, even of large, bearing trees, are much injured, and young, rapidly growing trees of very susceptible varieties are not infrequently killed. All varieties of quince are much damaged by the killing of branches and twigs, though the trees themselves are not often killed.

The disease is found in nurseries as well as in orchards.



Young pear orchard in early spring, showing blighted branches. The presence of the leaves indicates where the disease is. (Original.)

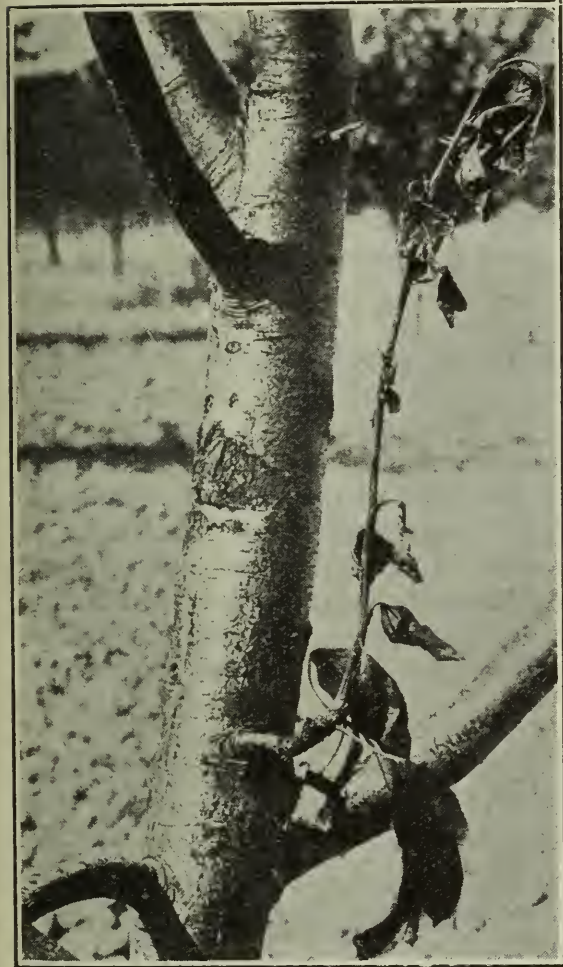
There is a great difference in the relative susceptibility of the various varieties both of apples and pears to attack. It is generally agreed that Clapp's Favourite is the most susceptible pear. Flemish Beauty and Bartlett are also quite susceptible, whereas Kieffer is least affected and Seckel is rarely severely attacked. Of apples, Alexander is usually the most susceptible and after it King, Tolman, Gravenstein and Rhode Island Greening. Among those least susceptible to infection are Spy, Duchess and Ben Davis. No variety, however, either of apple or pear, is entirely exempt, especially from infection through the blossoms, even Kieffer pears often having many blossoms blighted.

Symptoms — The disease manifests itself in several ways.

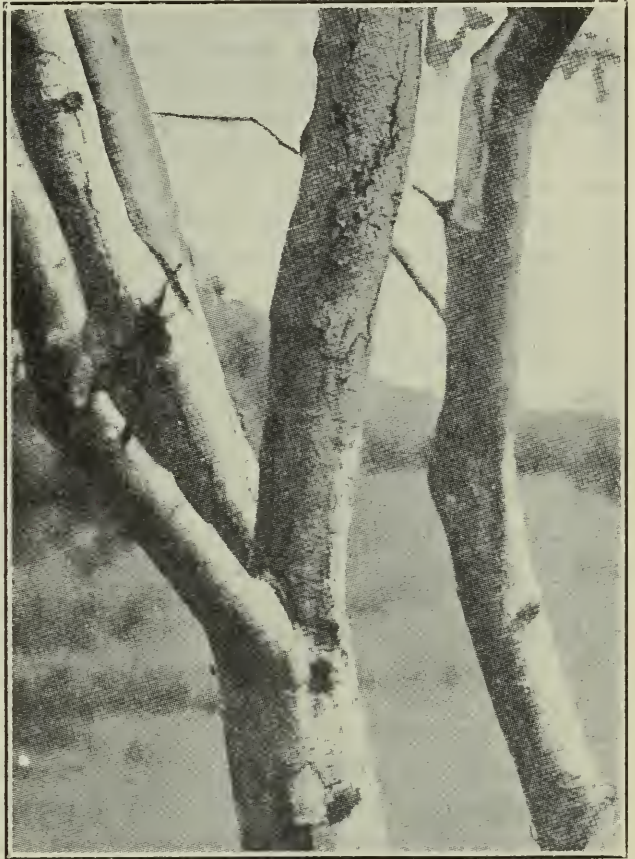
(1) In early June soon after the blossoms have fallen we often see the fruit clusters and the leaves immediately surrounding them wilting and dying, and in a few days turning brown on apples and nearly black on pears. There may be hundreds of such diseased twigs or fruit spurs on a single tree. This stage of the disease is usually called Blossom or Twig Blight, and is caused by the organism having been introduced into the blossoms by insects or by driving rains and becoming established there.

(2) Throughout the remainder of the season it is common to find watersprouts, suckers and branches of various sizes dying. The leaves on these usually do not drop but remain attached for months and sometimes even through the winter. Most of these later infections can be traced back directly or indirectly to the Blossom Blight mentioned above.

(3) Not infrequently the trunks and main branches become infected either as the result of the disease working down from smaller branches or from its



Blighted twigs on pear trunk. This disease runs down such twigs and enters the trunks or branches. (Original.)



Main limbs of a Flemish Beauty pear tree, O.A.C. orchard, in which the blight is rapidly spreading. The limb to the right is practically dead. Notice the cracking and blistering of the bark, especially on the middle limb. All the disease above the crotch developed this season from the cankered area below the crotch. It spread throughout the bark very rapidly during June, July and August. Photo taken in September. (After Jones.)

getting into a watersprout and running down this into the trunk or branch, or from direct inoculations by some bark or wood-infesting insect that had just previously fed upon a diseased part of some tree. All these cases are often spoken of as Body Blight. Roots of trees may also become inoculated through infected suckers, the disease running down these into them. On pear trees, infections of the trunk or main branches or roots are likely to mean the death of the trees unless the affected areas are promptly cut out and disinfected. But on apples, such infections usually live for only a few weeks and then die, though they often leave a dead area or canker varying in diameter from one to several inches. Very susceptible and succulent young apple trees are, however, sometimes killed outright by Body Blight.

(4) Occasionally the fruit becomes infected and is destroyed; but the total loss of fruit from this cause alone is small.

Cause of Blight — The disease is caused by a very tiny bacterial organism, known as *Bacillus amylovorus*. This is so small that at least 10,000 individuals could find room on the head of a pin. These germs work chiefly in the tender tissues of the bark and have marvellous powers of multiplying; millions may be produced from a single one in a day. They feed on food substances present in the living bark and soon kill the part attacked. Warm, moist weather, which causes rapid growth and a succulent condition of the bark favours greatly their development; whereas drought by checking the growth and thus lessening the succulence of the trees and especially of the bark soon checks the progress of the disease, and in many cases even destroys the organism itself. There seems, in fact, no reason to doubt that the variation in the amount and virulence of the disease over large areas one year compared with another must be attributed chiefly to the difference in the sort of weather that prevailed, though no one has yet been able to analyze fully all the effects of weather.

Means of Distribution — During the winter the Blight organism lives in the healthy bark that bounds the dead areas. In spring when the sap begins to move through the trees the germs begin to multiply and by the time the blossoms are opening, sometimes clog the tissues of the bark to such an extent that a sticky fluid containing countless germs breaks through to the surface. If this exudate happens to be high up on the tree driving rains will dilute it and carry the germs to blossoms below either on the same tree or on neighboring trees. Then bees or other insects visit these inoculated blossoms and spread the disease to other blossoms and inoculate these, and from them in turn thousands of blossoms here and there throughout the orchard may become diseased.

Another method of spread is through ants, which often feed upon the sticky exudate wherever it may be and thus get their mouth parts and feet covered with germs. These same ants a little later visit the blossoms to feed upon the nectar and thus inoculate them. Other insects as well as ants may act in this way. Then the bees, wasps and other bloom-frequentering insects visiting these same blossoms carry the germs to other trees.

After the blossoms have fallen and the disease has become well started on the twigs and fruit spurs, sucking or biting insects, such as aphids or bark beetles, which may happen to feed upon a diseased leaf or twig, can carry the germs on their mouth parts to new twigs and inoculate them. The chief time of distribution in an average year is during the blooming season, but some goes on all through the growing season.

Method of Control — **The first step** in control is to put the right man in charge of the work; for only a careful, observant and interested person is likely to make a success of it.

The second step — the one on which the success of the work will chiefly depend,— is to cut out and burn during the winter or early spring and never later than April 1st all diseased pear twigs and branches, and to remove all the bark over any local diseased area on the trunk or main branches. Trees, of course, in which the crotch or trunk is so badly diseased that there is no hope of saving them should be totally removed and burned. The object of this destruction of all diseased trees and parts of trees at this time of the year

is to remove as far as possible all sources of later infection, especially infection at blossom time. Any person who fails to do this early cutting and burning is going about the work in a wrong way and need not expect to control the Blight in a year favourable for its development.

An inexperienced operator will at first have considerable difficulty in detecting some of the diseased areas on the trees, especially where these are on the trunk or main branches and the part above still looks healthy. Hence he should first go through the orchard and remove all the branches whether large or small that he can plainly see have been killed by the disease, and in so doing observe the colour of the bark on these and how it differs from healthy bark. He should also note that on some of the larger branches diseased bark will not only be darker but also be swollen, more or less spongy and sometimes ruptured in many places. In this way he will soon get his eyes so well trained that he can readily pick out diseased areas anywhere, though certain shrunk places on the bark may at times give him trouble. These places are often in no way connected with Blight and are characteristic of pear trees. By cutting them through with a knife and observing that the wood beneath the inner bark is healthy he will be able to recognize that they are not diseased; for if Blight were the cause the bark and also the wood immediately beneath would either be dead or there would be reddish brown streaks present.

When the blighted branches are being removed they should always be cut a few inches below the limit of the dead area, because the disease germs, as stated above, winter over not in the dead bark but in the living bark adjoining the dead. In the same way when cutting out any dead area on the trunk or main branches, it is necessary to remove the living bark all around it as far back as there is any sign of the reddish-brown streaks; for such streaks are an indication of the presence of the disease.

The most convenient tools the writer has yet found for cutting out dead or diseased areas in the bark are a sharp drawknife and a stout jack-knife. A saw and a long-handled pair of pruners are good tools for removing branches and twigs. It is convenient, of course, to carry along also a pair of small hand-pruners.

Very few men, even though experienced, will be able to see and remove all blighted parts by merely going over an orchard once. The writer found it was always wise to go over every tree twice, and in some cases three times. This is specially true when the operator is inexperienced.

No disinfectant is necessary in this early cutting out of diseased parts, provided the work is finished before the sap begins to move through the trees in spring.

The third step — in control of Blight is to watch for the first indications of Blossom Blight and remove the affected twigs as soon as they show infection. Blossom Blight begins to appear about a week or a little later after the blossoms have fallen. The first indication of it is the wilting of the leaves around the little fruit clusters.

In order to prevent the disease from running down the infected twigs or fruit spurs into the main branches and thus making it much more difficult to treat, it is necessary to remove the twigs as quickly as they show by their wilting that they are infected. **Not a day should be lost in doing this.** The easiest and best method is to drive a truck or dray close alongside each tree and from it or from the ground or a step-ladder, break off every diseased twig

or fruit spur. It is much safer and quicker to break them off by hand than to cut them off, because in breaking there is no danger of spreading the disease and no need of using a disinfectant. All the twigs will not show the disease the same day, so it will be necessary to go over the trees about three or four times at intervals of a day or two to make a thorough job. So far as practicable the broken off twigs should be thrown on the truck or wagon and hauled off and burned. If this removal of the Blossom or Twig Blight is done promptly and thoroughly there will be very little further difficulty the rest of the season, though it will be necessary about once a month to look over the trees and remove any branches that have later become infected. In cutting these out it is very important to make the cut at least six inches, or if possible, a foot or more below the lowest sign of the disease on the bark, because the disease may have advanced several inches in the bark without showing any external evidence. If the branches are short examine the bark at the base, and remove it as far as it shows any indications of disease being present.

Disinfectants and Methods of Using Them — Corrosive sublimate, 1 part to 500 parts of water, was for a long time the disinfectant used, but recently it has been found that a better disinfectant is 1 gram corrosive sublimate and 1 gram of mercuric cyanide to 500 cc. of water. If there are many trees in the pear orchard at least half an gallon of this should be made up at a time by a druggist and kept in an earthen or glass vessel as it injures metals. The simplest method of using it is to carry along a bottle-full with a piece of sponge in the top instead of cork. Turn the bottle upside down until the sponge is wet then, after each cut, rub the wet sponge over the surface of the cutting tool and also of the cut on the tree.

Another disinfectant for pruning tools and wounds is made from 8 half gramme tablets of mercuric chloride, 8 half gramme tablets of cyanide of mercury, one pint of warm water and three pints of commercial glycerine.

Caution — These mixtures are deadly poison, and should be so labelled. All cuts made in the growing season must be disinfected, otherwise the saw or other cutting tool will soon become infested and will thus spread the disease.

A fourth helpful step in control is to remember that the disease often gets into the trunk and main branches by running down watersprouts and into the roots through suckers; hence it is a good plan to go through the orchard occasionally and rub off with the thumb all watersprouts while still small, and cut off below the surface of the soil all suckers.

A fifth measure — is not to encourage great growth and succulency of trees, because this favours the disease. Hence, after the trees have begun to bear or to blossom do very little pruning, and either grow them in a sod mulch or else lessen the amount of cultivation and of fertilizers.

It is also well in setting out new orchards not to plant Clapp's Favourite or the Alexander apple because of their great susceptibility to Blight and the menace they therefore are to the rest of the orchard. It is also wise as a rule not to plant apples and pears in the same orchard.

Young apple trees may be treated for Blight in the same way as pears, but that on large apple trees the cutting out of Blossom Blight is impracticable and not so important, because usually the disease dies out before entering the main branches or else soon after it enters. Where old apple trees are heavily blighted cease cultivation and put them into a sod mulch and try to remove all diseased branches as on pears in winter or early spring.

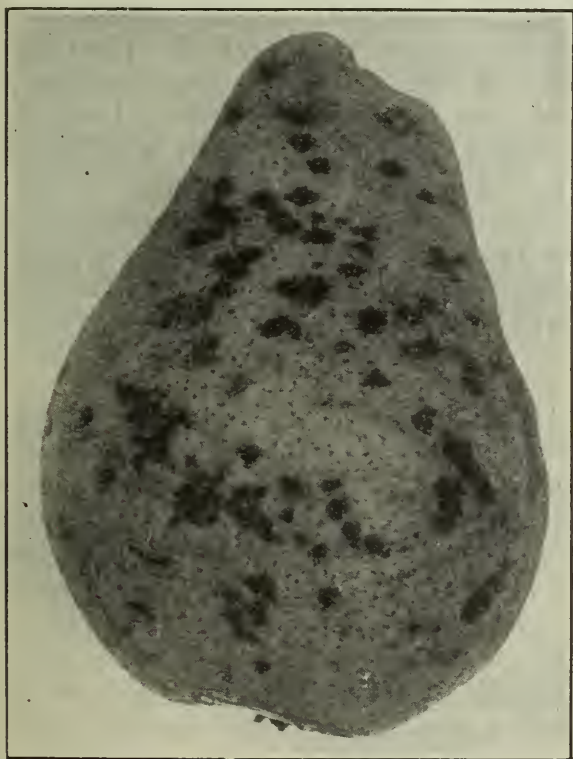
Recent experiments in the United States have shown that a large part of the Blossom Blight can be prevented by one or two sprays of weak Bordeaux mixture, 1-3-40, when the trees are in bloom. It has also been shown that large cankers on older wood can be rendered inactive by painting the bark over and for several inches around the diseased areas with a 43% solution of zinc chloride. This preparation composed of zinc chloride dissolved in alcohol, water and hydrochloric acid penetrates the bark and kills the bacteria. This treatment has limitations and is hazardous except when applied by a specialist. It is not recommended for general use by Ontario fruit growers, but there may be some men sufficiently skilled in detecting cankers, preparing chemical solutions and disinfecting wounds who might use it to advantage. It is claimed to give excellent results when applied by a specialist. Those interested in this zinc chloride treatment of Canker should secure Circular No. 62, "Fire Blight Canker Treatments," published by the Agricultural Experiment Station, Knoxville, Tennessee, U.S.A.

Note — For a much fuller account of this disease see Bulletin No. 342, by Professor D. H. Jones.

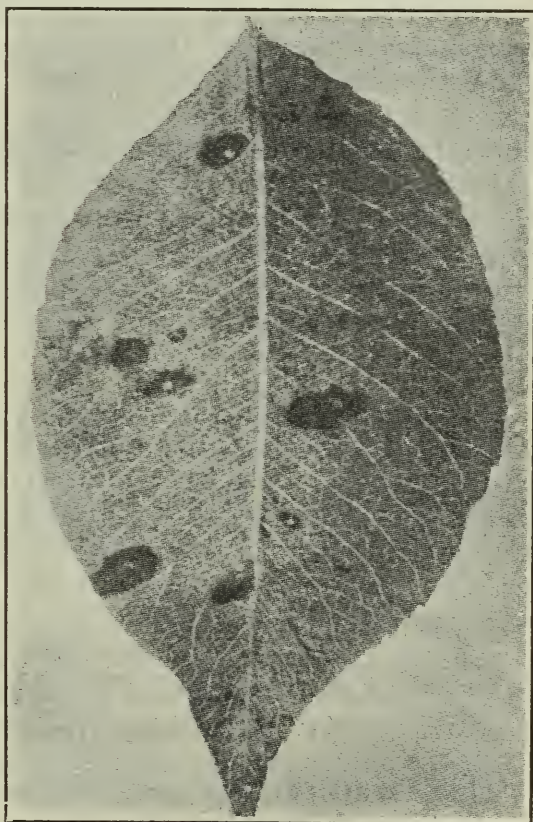
PEAR SCAB (*Venturia pyrina*, Aderh.)

Pear Scab is similar in nearly every respect to Apple Scab. In Ontario only the Flemish Beauty and a few of the less valuable and often unnamed varieties of pears are very subject to it. Scab is a great drawback to the otherwise valuable variety, Flemish Beauty. When the fruit is badly affected it is cracked open and rendered almost valueless for commercial purposes.

Life History — Very similar to that of the fungus which causes apple scab except for the fact that this fungus is carried over on the twigs to a much greater extent.



Pear Scab on fruit. (Original.)



(After V. B. Stewart.)
Leaf Spot on pear.

Prevention — Most varieties of Pear require only one application for the control of scab. This should be given soon after the blossoms have fallen with Bordeaux 2-4-40 and 1½ pounds lead arsenate. A special spray with 3% lubricating oil emulsion in late March or early April is necessary to control the pear Psylla, and sometimes, if the pear Psylla becomes abundant, it is necessary to spray with nicotine sulphate. See Spray Calendar.

The Flemish Beauty pear and other varieties very subject to scab should be sprayed first as the buds are bursting and, second, just before bloom; third, just after the blossoms fall and again in ten days. In very damp weather more applications are required. Use Bordeaux 3-6-40.

LEAF SPOT OF THE PEAR (*Mycosphaerella sentina* (Fr.) Schröt)

This disease is frequently seen in Ontario, though it seldom causes any appreciable harm except in badly neglected orchards or to trees growing wild on roadsides or in fence corners. It is sometimes observed in nurseries and occasionally results in premature defoliation which checks the growth of the young trees.

Symptoms — The disease is confined to the leaves, on which are seen small, somewhat angular spots, usually with grey centres and brownish or purplish-brown borders; but sometimes the whole spot is dark in colour, with no distinct grey central area. In the centre of the spots as they mature, small black specks, the fruiting bodies (pycnidia) of the fungus, appear. The size of the spots appear to vary with the variety and the season. When the disease is severe the spots may be so numerous as to injure the leaves markedly.

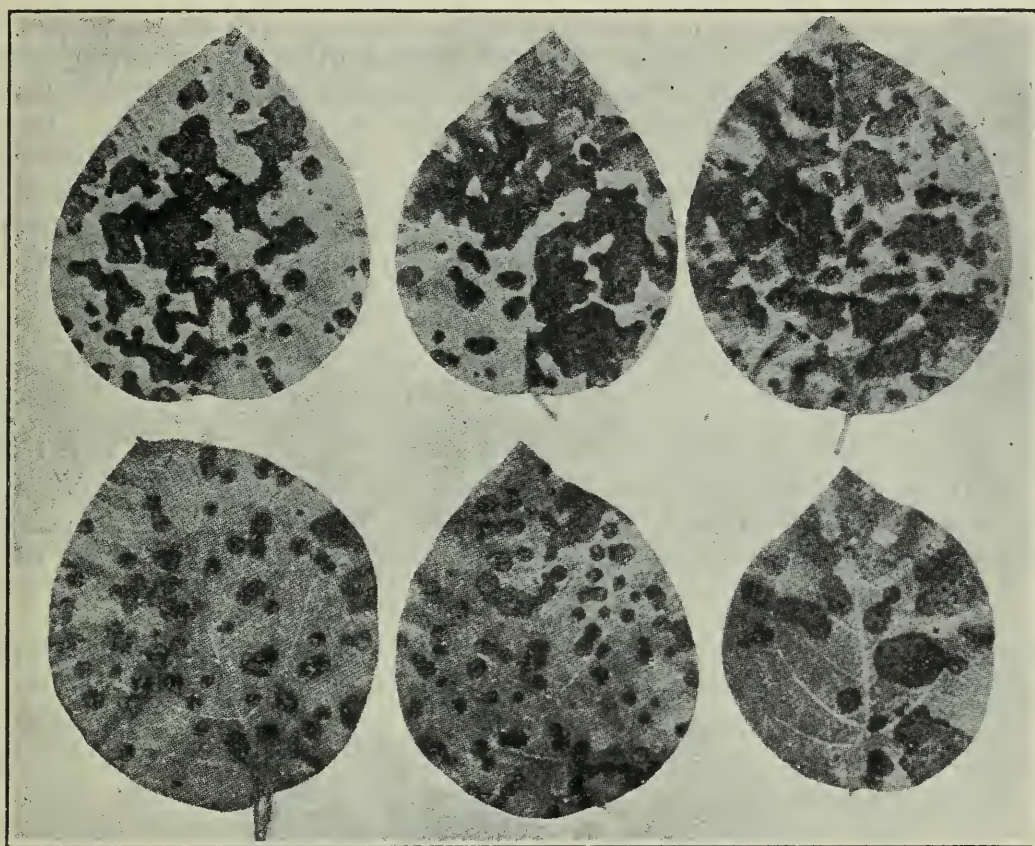
Life History — The tiny black specks or fruiting bodies (pycnidia) are filled with minute, slender, thread-like spores, which are discharged from a small opening at the tip of the fruiting body (pycnidium). They are scattered through the orchard by the wind and rain, and serve to spread the Leaf Spot during the summer months. Moisture is essential for the germination of these spores and for the penetration of the leaf by the germ-tube. Hence, it is that the Leaf Spot is always most prevalent in a wet season. The fungus lives over the winter in the fallen leaves. In these another form of spore (ascospores) is developed in a special kind of fruiting body (perithecium). These are discharged in the spring of the year, and some of them are blown by the wind to the newly developed leaves on which in a short time they produce the characteristic spots and the first generation of summer fruiting bodies (pycnidia).

Prevention — The sprayings which are given for Scab appear to control completely Leaf Spot. To control it on nursery stock spraying with Bordeaux mixture (3-6-40) or with commercial lime-sulphur 1 gallon to 40 gallons of water is recommended. The first application should be made just as soon as the trees come into full leaf in the spring, the second about two or three weeks later. In very wet seasons one or two more sprayings at intervals of about two weeks may be necessary.

LEAF BLIGHT OF PEAR AND QUINCE (*Fabraea maculata*, (Lev.) Atk.)

This is another disease of comparatively little importance in Ontario. It is seen on both pear and quince, but is usually more noticeable on the latter. It is chiefly a leaf spot disease, but the fruit is sometimes also affected. The spots on the leaves are small circular, dull red or brown in the centre

with darker borders. One or more black pimples, fruiting bodies (acervuli), of the fungus can be seen in the centre of each spot. In severe attacks the spots may be so numerous that the leaves turn yellow or brown and fall. Red and brown spots are sometimes also seen on the fruit. On the quince the disease is sometimes so severe as to cause a premature defoliation.



Leaf Blight of quince. (V. B. Stewart.)

Prevention — In orchards the sprayings as ordinarily given for Scab appear to control completely this disease on pears. On quinces it may be prevented by spraying with lime sulphur or Bordeaux mixture. Spray with commercial lime sulphur 1 gallon to 40 gallons of water or Bordeaux mixture (3-6-40). Give the first application shortly before the blossoms appear, and the second soon after they fall. In a wet season a third spraying may be required about ten days later.

PEACH LEAF-CURL (*Exoascus deformans* (Berk.) Fckl.)

This is the most common and most injurious fungus disease of the peach. It is familiar to every peach grower, and very frequently seriously impairs the vitality of his trees.

Symptoms — Blossoms, young fruits and twigs are sometimes affected but it is by the destruction of the leaves that the chief injury is done. The leaves are usually infected before they emerge from the buds in the spring. They become distorted, curled, thickened and yellowish-white, pinkish or purplish in colour. A little later in the season they turn brown and fall. The disease may spread from the leaves into the shoots and destroy them. In severe attacks of Peach Leaf-Curl the trees are almost completely defoliated, the fruit is stunted or drops to the ground, and the vitality of the trees is so impaired that they are likely to be severely injured by the cold the following

winter. The proper development of fruit buds is also prevented. Young trees may be killed the first year they are set out if they are defoliated before they have recovered from the shock of transplanting. Peach Leaf-Curl is always more severe in cold wet springs.

Life History — On the surface of the affected leaves numerous spores are produced, and the fungus which causes Peach Leaf-Curl is thought to be carried over the winter by some of these spores adhering on or between the bud scales. In the spring, when the buds begin to swell with warmth and moisture, the spores germinate and infect the unfolding leaves. Hence the necessity for early and thorough spraying. In cold wet springs the opening of the buds is retarded, while the germination of the spores and the development of the fungus is favoured by the excessive moisture and not retarded by the cold. Thus the fungus has plenty of time to get established in the tender tissues of the developing leaf. This explains why Peach Leaf-Curl is always worse in cold wet springs.

Prevention — Spray before the buds swell, March or Early April. In districts where there is danger of San Jose Scale use lime sulphur 1-7, or 3% lubricating oil emulsion and Bordeaux 3-6-40. In sections of the Province where there is no danger of San Jose Scale use lime sulphur 1 gallon to 15 gallons of water, or Bordeaux mixture 3-6-40. Spraying must be done early in the spring, before the buds have started to swell, and care must be taken to see that every bud is thoroughly covered.

Success depends upon early, thorough spraying as can be understood from a consideration of the life history of the fungus.



Peach Leaf-Curl

PEACH YELLOWS AND LITTLE PEACH

These two diseases are closely associated in the orchard, and are very similar in nature and, therefore, will be discussed together. They are both very destructive and much feared by all peach growers who have had an opportunity to see the damage they can do. In the past they have literally destroyed thousands of peach trees in the Niagara district. Serious loss from them in the future can only be prevented by a rigid application of the control practices recommended by those who have studied these diseases for years.

Those interested in these two diseases can secure further and more detailed information concerning them by consulting the Ontario Department of Agriculture Bulletin 383, "Peach Yellows and Little Peach," by L. Caesar and G. G. Dustan.

Host Plants — Both diseases attack peaches and Japanese plums and are reported as occurring also on apricots, nectarines and almonds. Recent investigations in the United States would seem to show that our native American plums and also European varieties may perhaps, at times, be infected without showing any symptoms of either disease. Japanese varieties are decidedly susceptible and, therefore, an important source of danger to peaches, as it is difficult to recognize the symptoms on them. All varieties of peaches and Japanese plums seem to be susceptible to both diseases.

Symptoms of Peach Yellows — (1) **Premature ripening of the fruit.** The most conspicuous symptom of Yellows, and often the only one on trees just beginning to show the disease is the presence of prematurely ripened fruit on one or more branches, or sometimes on the whole tree. These fruits ripen from one to two weeks before the normal time for the variety and are usually a little larger than normal the first year but smaller after that. Such fruits are usually more highly coloured than normal, and may be knobby or bumpy, often blotched outside with red, streaked inside with the same colour, and often have the flesh around the pit abnormally red. Sometimes, however, the flesh of such fruits is normal in appearance. The flavour is usually very insipid and unpalatable, but sometimes it is moderately good. (2) **Foliage Discolorations.** The most common symptom of Yellows, and the one from which it probably gets its name, is the yellow or bronze yellow colour of the leaves. The foliage on at least some of the branches is nearly always a sickly, yellow colour, and is often clustered and curled as described below for Little Peach. Trees affected with Little Peach show the same foliage discolorations, hence by the foliage alone it may be very difficult or impossible to determine which disease is present. This, of course, is not important from a practical standpoint for both are fatal to the tree.

Another foliage characteristic common to both Yellows and Little Peach is that unless the trees have been diseased for a year or more the foliage at the tips of the affected branches for a few inches to a foot back is still quite green in contrast with the characteristic yellowing of the foliage below on the same branches. (3) **Broom-like Growths.** On the trunks, or more commonly on the main branches, one or more little, wiry growths or sprouts develop, characterized by their slender stems and small, narrow, willow-like, pale yellow leaves. These sprouts may be only a couple of inches high or may reach a foot or a little more. As they grow they send out fine branches close together, and these become bushy or broom-like. They always grow upright. These peculiar, yellow, bushy growths, while a very convenient means of identification of the disease, are by no means common and are found

on only a very small percentage of infected trees. They seem to be limited almost entirely to trees which have been diseased for more than a year and consequently have also other foliage or fruit symptoms of Yellows present.

Symptoms of Little Peach — (1) Small, Late Ripening Fruits. The fruit on trees infected by Little Peach is usually smaller than normal, and in most cases from one to three weeks later in ripening. The smallness of the fruit,



Branch of tree affected with Little Peach just beginning to show the clustering and curling of the leaves near the base as indicated by the arrows. (Original.)

when taken in conjunction with foliage symptoms, is a valuable aid in making diagnosis easier, but cannot be relied upon alone as small, late-ripening fruit may be caused by other factors such as poverty of the soil, drought, or injury to the leaves or trunk, or even by the individuality of the tree itself.

(2) Clustered, Discoloured Foliage. The symptom, chiefly to be relied upon in diagnosing Little Peach is the appearance of the foliage. As already mentioned, the foliage symptoms of Yellows and Little Peach are very similar. It is said, however, that the foliage symptoms in Little Peach, in most cases, show up a little more clearly and definitely than they do in Yellows. Briefly, they are: the yellowing or bronzing of the leaves, and the bunching or clustering of these here and there, and also the fact that the terminal leaves or outer part of the tree are usually green from the tip back for about 4 to 12 inches in contrast with the yellowish colour of those lower down.

Cause of Yellows and Little Peach — Extensive research work indicates that both Yellows and Little Peach are what are known as virus diseases. These are diseases caused by something which cannot be seen with the aid of the most powerful microscope, but, if transferred in a proper manner to a healthy plant, will cause the disease.

How these Diseases are Spread — It has been proved that these diseases are spread in two ways: One is by inserting a bud, scion or section of bark from a diseased tree into a healthy one, and the other by the plum leaf hopper (*Macropsis trimaculata* Fitch) feeding first on a diseased tree and then on healthy trees.

It is clear from the above that these diseases might be introduced into an orchard by planting one or more infected trees from a nursery and then spread through the orchard by the plum leaf hopper.



Leaves from Little Peach tree, showing the characteristic flattening and curling. (Original.)

Methods of Control — Once a peach tree develops either disease it never recovers, and it is a serious source of danger to all trees near it. The most important step in control, therefore, is for the local inspector or the grower himself to mark clearly every diseased and suspicious tree and take it out and burn it promptly. Japanese plums should also be inspected and removed if diseased. Nurserymen, also, can help to prevent the distribution of these diseases by making sure that their bud sticks come from orchards which are known to be free from both diseases.

The plum leaf hopper, being the carrier of these diseases, and the plum being its favorite host, it is advisable when setting out new trees to keep plums and peaches a hundred yards or more apart, if possible, so that the hopper is less likely to go from plums to peaches. It is also recommended to spray the plums and that part of the peach orchard nearest them, with nicotine sulphate, one pint, and soap five pounds to 100 gallons of water, to kill the young leaf hoppers. This should be done about the first week in June.

BROWN ROT OF STONE FRUITS (*Sclerotinia cinerea* (Bon.) Wor.)

This, as the name implies, is a disease of peaches, cherries, plums and apricots. It is to be seen in Ontario to a greater or less extent every year, and in some seasons causes very serious damage, especially to certain susceptible varieties of peaches, to sweet cherries, and several varieties of European plums.

Symptoms — Blossoms, fruits, leaves (sweet cherries), and twigs are affected. It is by the destruction of the fruit that the chief loss is caused. It first appears as a small, brown spot which gradually increases in size until the whole fruit becomes soft, brown and rotten. These rotten fruits retain their form for a time, but finally they dry out and become shrivelled, hard and wrinkled and are known as "mummies". These are frequently seen hanging on the trees or lying on the ground underneath. On the surface of the rotten fruits greyish-brown, velvety spore pustules are easily seen with the naked eye. The fruit becomes more subject to rot as it approaches ripeness. Sometimes, however, the young green fruits are destroyed by the disease. The blossoms are sometimes attacked. They turn brown and fall. Blossom rot is quite common on cherries and peaches in Ontario. Sometimes the fungus which causes the rotting of the fruit or blossoms grows back into the twigs and girdles them and thus causes a twig blight. This is most frequently seen in the case of certain susceptible varieties of peaches but is not uncommon on cherries and plums. On sweet cherry leaves, brown dead areas due to this disease are common when the rot is bad on the fruit.

Life History — The fungus which causes the disease is spread during the summer months by means of spores produced in great numbers on the surface of the rotting fruits. These are scattered by rain, wind, insects and other agencies. In warm, muggy weather the rot is spread by them very rapidly, especially when the fruits are close together and the foliage so thick as to keep out light and prevent the free circulation of the air.

The fungus which causes the disease is carried over the winter in various ways:—



Mummified plums and peach, due to Brown Rot. About one-half natural size. (Original.)

1. By means of the mummied fruits hanging on the trees or lying on the ground beneath. In these the mycelium of the fungus remains alive all winter and in the spring, when they are soaked by rains, the fungus threads may grow again and produce fresh crops of spores (conidia) on the surface. From some of the mummied fruits lying on the ground underneath the trees partly covered by the earth, about blossoming time, little trumpet-shaped growths (apothecia) are produced. These contain immense numbers of another kind of spores (ascospores), which are discharged into the air and may be blown up into the trees, where, if weather conditions are favourable, they may infect the blossoms or young fruit and cause them to rot. These trumpet-shaped growths (apothecia) have been observed in Ontario every year since 1912, and probably play an important part in initiating the disease in the spring.

2. By means of spores produced during the summer adhering to the mummied fruits and probably to bark and bud scales. These retain their vitality and are capable of causing infection and producing disease again in the spring.

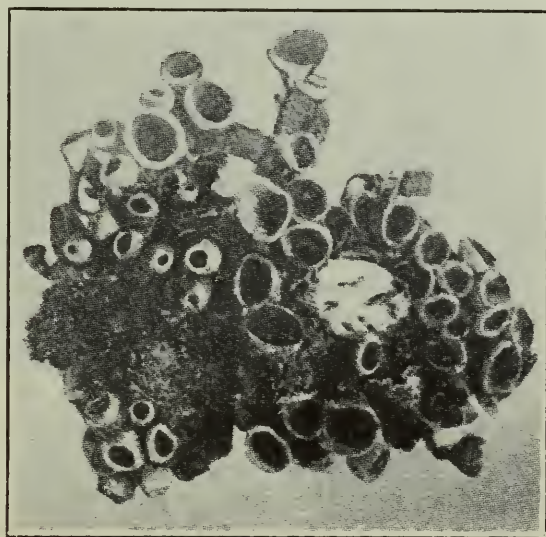
3. To some extent by means of dormant fungus threads (mycelium) in the blighted twigs.

It will be seen from the above account of the life history of the fungus, that the mummied fruits are chiefly instrumental in perpetuating the disease from year to year.

Prevention — Prune the trees to let in light and air and to facilitate spraying.

Peaches — Spray peaches first in the early spring before the buds swell, March or early April. In districts where there is danger of San Jose Scale use lime sulphur 1-7, or 3% lubricating oil emulsion and Bordeaux 3-6-40. In those parts of the Province where there is no danger of San Jose Scale, use lime sulphur 1-15, or Bordeaux 3-6-40. Give a second spray three to four weeks before picking. Use a wettable sulphur or dust with sulphur. No poison. Just before picking, dust with sulphur or spray with prepick wettable sulphur.

Sour Cherries:—If the weather is wet during blossom time spray with Bordeaux 2-4-40. No poison. Give a second spraying when most of the shucks are off. Use lime sulphur 1-40, 3 lbs. hydrated lime and either 1½ lbs. lead



Spring stage of the Brown Rot fungus on a peach, buried just at the surface of the ground. (After McCubbin.)

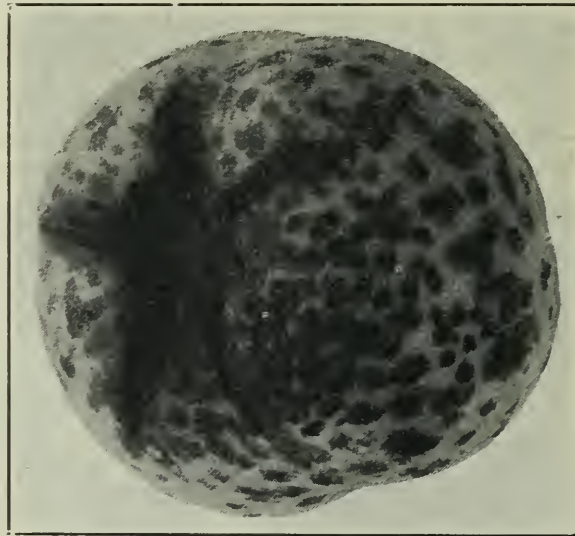
arsenate or 1 lb. calcium arsenate. Give a third spraying twelve days after the second. Use the same spray mixture as for the second spray. If the weather is very wet use Bordeaux 3-6-40 and poison for the second and third spray to prevent leaf blight or yellow leaf. Spray again when Early Richmonds are beginning to colour. Spray late varieties again when Montmorencies are beginning to colour. Use lime sulphur 1-50 and lead arsenate 1 lb. Spray ripening cherries with prepick wettable sulphur. This will prolong the picking period.

Sweet Cherries:—Spray when most of the shucks are off. Use lime sulphur 1-40, 3 lbs. hydrated lime and either $1\frac{1}{2}$ lbs. lead arsenate or 1 lb. calcium arsenate. Give a second spraying twelve days later. Use the same spray mixture as for the first spray. Spray again when the early varieties are beginning to colour. Use lime sulphur 1-50 and lead arsenate 1 lb., but omit the poison on Black Tartarian and earlier varieties. Spray ripening cherries with prepick wettable sulphur to prolong the picking period.

Plums:—Spray first just before the buds burst. Use 3% oil emulsion with 3-6-40 Bordeaux, or use lime sulphur 1-7. Give a second spraying as soon as most of the shucks are off. Use lime sulphur 1-40, 3 lbs. hydrated lime and either $1\frac{1}{2}$ lbs. arsenate of lead or 1 lb. calcium arsenate. Give a third spray twelve days later. Use the same mixture as in the second. Varieties of plums very subject to rot should receive two more sprays, one with lime sulphur 1-50 two weeks before picking, and another with Prepick wettable sulphur just before picking, or they may be dusted with sulphur just before picking.

PEACH SCAB (*Cladosporium carpophilum* Thum)

This disease is frequently seen in Ontario. It is especially troublesome on white fleshed varieties. Elberta peaches, however, are frequently spotted by it. In some years it causes marked disfigurement of the fruit of susceptible varieties.



Peach Scab—a very severe infection.
(Original.)

Symptoms:—Small, circular, sooty black spots are seen on the surface of the fruits. These may be scattered all over the surface, or more or less confined to certain areas. In severe infections the spots may be so numerous as to disfigure the fruit badly, and to cause cracking occasionally. Twigs and leaves are sometimes affected. On the twigs develop small, more or less circular blotches, yellowish brown in colour with a dark grey or purplish border. Affected leaves have on them small reddish brown scattered spots, especially along the mid rib and margins.

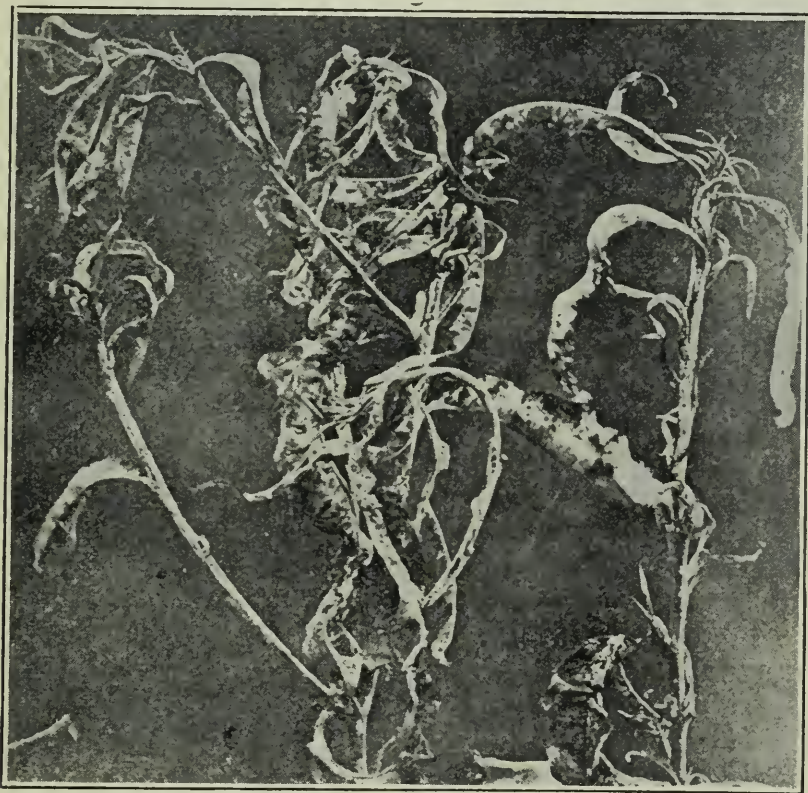
Life History:—The fungus that causes scab winters over as dormant fungus threads, mycelium, in the lesions on the twigs. In the spring these fungus threads produce little spore pustules. These are scattered by wind, rain and insects, and infect the fruit and leaves.

Prevention:—This disease can be prevented by spraying as directed in the Ontario Spray Calendar for Pears, Stone Fruits and Bush Fruits. Such spraying protects peaches from peach leaf curl, brown rot and scab. If peaches are sprayed for scab only, spray first about three weeks after the fruit is set and give a second application two weeks later. Use a wettable or bentonite sulphur according to the manufacturer's directions.

POWDERY MILDEW (*Sphaerotheca pannosa* (Wallr.) Lev.)

This mildew is frequently seen in Ontario. It does most damage to young peach trees which have not yet come into bearing and to nursery stock. It does, however, sometimes occur on older trees. Certain varieties are particularly susceptible to it.

Symptoms:—The mildew attacks the leaves, young shoots, and sometimes the fruit. The leaves and young shoots become covered by a dense, powdery, white fungus growth. Affected leaves become stunted, curled, pale, sickly, and more or less folded lengthwise. This mildew develops most vigorously in warm, moist weather, and is usually most abundant late in the summer and autumn.



Powdery Mildew on young peach twigs in nursery. Note the distorted, slender leaves, almost white with the fungus spore masses. (After Duggar.)

Prevention:—At the first sign of the mildew spray with a wettable or bentonite sulphur (strength according to the manufacturer's directions) or dust with sulphur and repeat at intervals of ten days as often as may be required to hold the disease in check.

CROWN GALL

(*Pseudomonas tumefaciens* Erw. Smith & Townsend)

This is a bacterial disease which affects peaches, apples, plums, cherries, raspberries and many other plants. It is easily recognized by the woody, knot-like swellings seen on the trunk and roots. These galls vary in size. Some are not as large as a walnut, while some may be as large as or much larger than a man's fist. When these galls are on the trunk they are usually at or just below the ground. The extent of injury done to the tree by Crown Gall is an open question. Many affected trees continue to grow and appear to thrive normally. There is no doubt, however, that some trees are weakened and stunted, if not killed by the presence of the galls. Hairy Root of Apples, often seen in nursery stock and easily recognized by the tufts of thread-like rootlets replacing the branches on the main root, is caused by a similar organism.



Crown Gall on Apple. (Original.)

Prevention — In order to be on the safe side do not plant any trees showing indication of Crown Gall. Such trees should be returned to the nurseryman with the request for healthy trees to take their place. It is not advisable to plant fruit trees where raspberries have been grown, as raspberries are very subject to this disease. Care should be taken not to injure the crown and root of fruit trees as it is chiefly through wounds that the bacteria enter them. Trees that are so badly affected with Crown Gall as to be unprofitable should be removed. In the nursery seedling trees showing any signs of Crown Gall should never be used for grafting purposes. *Experiments conducted in the United States indicate that it is advisable to dip grafts in organic mercury solution (semesan) or Bordeaux mixture (1) after grafts have been well fitted and carefully wrapped; (2) just before planting.

*A Method for Control of Crown Gall in the Apple Nursery, U.S.D.A. Circular 376.

PEACH CANKER

This is a serious disease very common and widespread in Ontario Peach orchards. All the more important varieties appear to be susceptible to it. It causes large conspicuous gummy cankers on the larger limbs and Twig Blight in the tops of the trees, often followed by Heart Rot and general loss of vigor. It is a common thing to see large black gum-covered cankers, chiefly on the upper side of the larger branches. These cankers do not usually heal over, but continue to widen and enlarge until finally the whole branch dies. This generally takes several years.

Peach Canker in Ontario is caused by a fungus, *Valsa cincta*, Fr., which gains entrance through dead areas and wounds in the bark. Infection is said

to occur most readily shortly before and for some time after leaf fall, and to a lesser extent during the remainder of the dormant season. Pruning stubs and injuries provide an entrance for this fungus, as do injuries caused by cultivators, pickers, and various insects such as the Oriental Peach Moth



Small cankers on peach branches. Natural size.
(Original.)

and Peach Borer. Dead lesions on twigs caused by the Brown Rot Fungus also provide an entrance for the Canker Fungus. Cultivation too late in the summer and the excessive or late application of fertilizers prevent the trees from becoming properly matured before winter and render them more susceptible to Canker.

Prevention: 1. Do not prune Peach trees in the fall when the wounds will be slow in healing. Pruning should not be done earlier than the middle of January. March and April are the best months to prune Peach trees for Canker control, but press of work prevents many growers from pruning at this time. 2. Practise close pruning so as to leave no stubs and avoid unnecessary wounds. 3. Remove all dead wood from the trees at pruning time and see that none is left in them during the summer. 4. Gather and burn all prunings as soon as possible. 5. Do not cultivate the orchard later than the first week in July. 6. Plan a fertilizer program that will maintain the fertility of the soil without prolonging the growth of the trees too late in the season. 7. Spray for the control of Brown Rot and remove rotting and mummied fruits from the trees. 8. Large cankers on trunks and larger branches which can not be removed should be treated in the early spring. All gum and bark should be removed and the wound immediately disinfected with Mercuric Chloride, 1-500 (Corrosive sublimate 1 oz. to 3 gallons of water), and then covered with a non-injurious water proofing preparation such as White Lead mixed with boiled Linseed Oil without Turpentine, or with any approved asphalt preparation.

BLACK KNOT OF PLUMS AND CHERRIES (*Plowrightia morbosa* (Schw.) Sacc.)

This is an extremely destructive disease, and in localities in Ontario where no special efforts have been made to control it, it has destroyed numerous cherry and plum trees. In well-cared-for orchards it is kept under control and seldom causes serious injury. This is particularly true of orchards in the fruit growing sections where spraying is generally practised and where the law requiring the cutting out of Black Knot is enforced.



Black Knot on plum twigs.
(Original.)

Varietal Resistance — Plums on the whole are said to be more susceptible than cherries. Japanese plums appear to be more resistant than those of the other species. Among the European plums *Reine Claude* and *Lombard* are very susceptible. The *Damson* plums also are extremely susceptible. Sour cherries are much more susceptible than sweet cherries. Wild plums and wild cherries are also susceptible.

Symptoms — The knots appear either in the fall or early spring. They are usually observed by the grower in the spring. The swellings are at first slight, but gradually increase in size. The surface becomes cracked lengthwise and covered with a light, green coating, consisting of numerous fungus threads (mycelium) and spores. The swellings are often spindle-shaped and usually more or less confined to one side of the twig. Later in the season, as the knots mature, they lose their green colour and become dry, hard, black and crack-

ed, with the surface studded with minute, black pimple-like structures, which are the fruiting bodies (perithecia) of the fungus. The knots are most abundant on the twigs and smaller limbs, but are sometimes found on the larger limbs, especially in the crotches. Occasionally they occur on the trunks.

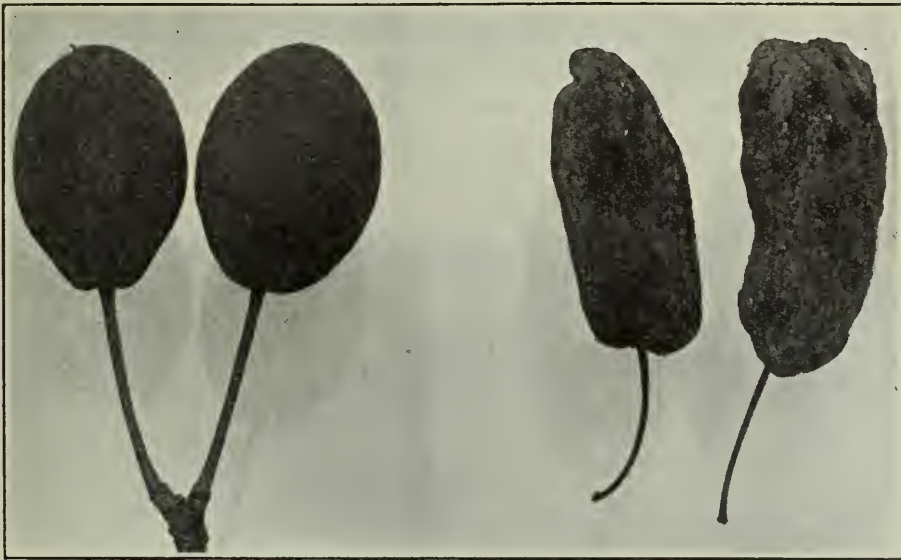
Life History — From June until fall numerous spores (conidia) are produced on the young developing knots, so that each is a source of infection to healthy limbs on the same tree and on other trees in the neighborhood. During the fall and winter months another form of spore (ascospores) develops in the black pimples (perithecia) on the surface of the mature knots. These spores are mature and are discharged from March to June. Most of the infection occurs in May and June on the wood of the current season's growth. The mycelium of the fungus is also perennial in many of the knots, so that they enlarge, producing fresh crops of spores each year.

Prevention: (1) Cut out and burn the knots, taking care to cut well below the diseased areas at least four inches if possible. This should be done thoroughly at least twice a year. In the fall or winter all knots should be removed before the end of February, and in the late spring or early summer any fresh knots, which may be developing, should be removed. The knots must be burned to prevent the fungus from spreading back to the trees again. (2) Spray plums and cherries as recommended for Brown Rot. In plum

orchards badly affected with Black Knot apply an extra spray when most of the petals have fallen. Use lime sulphur 1-50. (3) Co-operation is essential in the control of Black Knot. This, in Ontario, is usually brought about by the enforcement of the clauses of the Fruit Pests Act regarding the cutting out of knots.

PLUM POCKETS, (BLADDER PLUMS) (*Exoascus pruni* Fuckel)

This disease is common in Ontario on wild plums and on cultivated plums of the American varieties (*Prunus americana* and *P. nigra*). It is recorded also as sometimes occurring on the common or European plums (*Prunus domestica*). It is most prevalent in cold, wet springs. It cannot, however, be regarded as a disease of any great economic importance.



Plum Pockets or Bladder Plums. The fruit on the left is healthy, that on the right is diseased. (Original.)

Symptoms — Soon after the fruit is set it becomes swollen, hollow, without a pit or stone, and often distorted in shape. These light, hollow, bladder-like fruits have suggested the common name "Bladder Plums."

In the early stages affected fruits are yellowish or reddish in colour. Later they become covered with a whitish bloom. This is due to the production of numerous spore sacs (asci) on the surface. These sacs (asci) contain ascospores. After these are discharged the fruit turns dark brown in colour and falls off.

Life History — The fungus which causes Plum Pockets appears to live over the winter as spores, adhering on or between the bud scales. These germinate and produce infection of the young ovaries when the buds are bursting in the spring.

Prevention — Spraying as recommended for Peach Leaf-Curl appears to prevent this disease entirely.

LEAF SPOT, SHOT-HOLE FUNGUS, YELLOW LEAF DISEASE OF CHERRIES

This is a very common and an exceedingly serious disease in Ontario. It is seen on wild and cultivated cherries and plums. It does most damage to cherries. Both sweet and sour cherries are frequently completely defoli-

ated by it in wet seasons. In the years 1915, 1916 and 1928, it was particularly bad. It is usually regarded as doing most damage to sweet cherries, but here in Ontario it has been destructive to sour cherries.

The disease on the different species of cultivated and wild cherries and plums is not all caused by the same fungus. Three closely related species of Fungi, each confined to certain species of cherries or plums, have been found to cause it. *Coccomyces hiemalis*, Higgins, causes the disease on sweet and sour cultivated cherries and on the wild pin cherry; *C. pruniphorae*, H. on cultivated plums of the European and American varieties, and on two species of wild plum; *C. lutescens*, H. on wild black cherry, choke cherry and perfumed cherry.

Symptoms — These vary with different hosts. On the leaves of plums and wild cherries brown spots are produced, some of which soon fall out, leaving little holes, which give the leaf a “shot-hole” appearance. On cherries the spots on the leaves do not as a rule drop out so readily and are smaller. They are reddish-brown in colour and may be very numerous, so that nearly the whole surface of the leaf may be covered by them. Badly affected leaves turn yellow and drop. Cherry trees are frequently completely defoliated.



Leaf Spot or Shot-hole Fungus on cherry and plum. (Original.)

early in the summer. Such defoliation prevents the proper ripening of the wood and renders the tree very subject to winter killing. In the spring and summer of 1916 numerous instances were recorded of cherry trees not surviving the winter. When inquiries were made it was found in nearly every case that the trees which were winter-killed had been defoliated by Leaf Spot the previous summer.

Life History — On the surface of the spots on the leaves numerous spores are produced. These can often be seen as little white, velvety pustules in the spots, usually on the under side of the leaf. These spores serve to spread the disease during periods of wet weather in the summer. Moisture is necessary for its spread. It is only in wet seasons that it causes serious injury. The fungus which causes the disease is carried over the winter in the fallen leaves. In these it produces fruiting bodies in great numbers. The spores from them are carried by the wind to the young leaves, where they produce the first infection of the season, from which the characteristic spots develop a week or two later.

Prevention — Spray sour cherries first when most of the shucks are off; second, twelve days later. In a wet season for these first two sprays use Bordeaux 3-6-40, and either $1\frac{1}{2}$ lbs. lead arsenate or 1 lb. calcium arsenate. If the weather is comparatively dry, for these first two sprays use lime sulphur 1-40, 3 lbs. hydrated lime and either $1\frac{1}{2}$ lbs. lead arsenate or 1 lb. calcium arsenate. Then spray again when the Early Richmonds are beginning to colour. Spray late varieties again when Montmorencies are beginning to colour. For these late sprays use lime sulphur 1-50 and lead arsenate 1 lb.

Spray sweet cherries when most of the shucks are off. Use lime sulphur 1-40, 3 lbs. hydrated lime and either $1\frac{1}{2}$ lbs. lead arsenate or 1 lb. calcium arsenate. Give a second spray twelve days later with the same spray mixture. Spray again when the early varieties are beginning to colour. Use lime sulphur 1-50 and lead arsenate 1 lb., but omit poison on Black Tartarian and earlier varieties.

POWDERY MILDEW OF CHERRY (*Podosphaera oxyacanthae* (D.C.) DeBary)

This Mildew is frequently noticed on cherries in Ontario. It does not usually injure old trees to any great extent. Young trees and nursery stock, however, are sometimes severely injured by it. Apples and plums are also affected by the same mildew, especially nursery stock.

Symptoms — The young shoots, tips of branches and leaves become covered with a white powdery mildew. On the leaves it is most abundant on the lower surface. In severe attacks shoots and twigs are distorted and stunted and the leaves curled. Early in the season the mildew is white and more or less powdery, especially on young shoots and twigs. Later it becomes darker in colour. If the mildew on the lower surface of a leaf is examined at this time numerous dark specks will be seen scattered among the white threads. These impart the darker colour to the mildewed areas.

Life History — On the surface of the leaves and shoots the white threads of the fungus (mycelium) can be seen with a hand lens. During the early summer from these white threads stalks are sent up which bear chains of spores (conidia). These spores are so numerous that they give to the mildew the characteristic powdery appearance. They serve to spread the disease during the summer months. Towards autumn minute specks are seen among the fungus threads. These are at first yellow, later black in colour. They are fruiting bodies (perithecia), and each contains one large spore sac (ascus) with eight spores (ascospores) inside. These spores serve to carry the fungus over the winter. In the spring they are liberated.

Prevention — The sprays recommended for the control of Cherry Leaf Spot usually keep the Mildew under control. If Mildew appears dust immediately with sulphur and repeat the dusting at intervals of ten days until from three to five applications have been made, depending upon the severity of the disease. If a duster is not available spray two or three times at intervals of about ten days with a wettable or bentonite sulphur.

WINTER INJURY

In this Province which is subject to cold winters and great extremes of temperature, winter injury or injuries caused by low temperature are common and very important. Our climate is such that the more tender fruits can not be grown profitably outside the Niagara Peninsula and a few other favourably situated areas. Apples are grown all over Old Ontario, but many varieties have been planted which have not proved hardly enough for the districts in which they have been set out. There has been consequently much loss from winter injury in many parts of the Province. Winters have occurred in which even some of the more hardy varieties of apples have suffered severely. In the winters of 1917-18 and 1933-34 severe losses were suffered by apple growers all over the Province, except in the Niagara district and in the Counties of Essex and Kent.

In the winter of 1933-34 hundreds of mature apple trees throughout the Province were killed outright or were so severely injured that they were worthless, and many of them died in subsequent years. During that winter cold weather was very long and severe. Near zero weather occurred in October. In November below zero temperatures were experienced, and in December there were many days below zero. At Guelph the temperature dropped to 19° below zero on December 29th. In January there were also many days below zero. In February at Guelph, on the 8th, 9th and 10th it was 27°, 26.5° and 26° below zero respectively. March was also very cold, the thermometer dropping to near zero many times. It was not determined in just what part of the winter the severe damage was done. It might have occurred in the early cold weather before Christmas, during the extremely cold wather of February, or in the abnormally cold March. All three periods probably caused more or less injuries.

Young trees, on the whole, withstood the cold much better than mature ones. Trees which bore little or no crop the previous season suffered less than those which bore a heavy crop. Neglected, starved trees were more severely damaged than properly cared for vigorous ones. Trees which were too heavily fertilized, especially with nitrogen, or were given cultivation too late in the season and thus prevented from properly maturing their wood before winter, suffered to a much greater extent than those with well matured wood when cold weather came.

It is interesting to note that in the very cold winter, 1933-34, the following varieties of apples suffered comparatively little: Melba, McIntosh, North West Greening, Duchess, Wealthy, Wolf River, Salome and Milwaukee. Among those varieties which suffered moderately severe injury were Scarlet Pippin, Pewaukee, Tolman, Spy, Golden Russet, Hubbardston, Stark, Delicious and Snow. In the Eastern and coldest areas, Snow suffered severely. The varieties which were most severely injured were Baldwin, King, Jonathan, Wagener, Ontario, Grimes Golden, Gravenstein and Rhode Island Greening. In most localities nearly all the Baldwins and Kings were ruined.

The lessons learned from the severe winter of 1933-34 were: first, the necessity of hardier apple trees for many parts of the Province. These, it has been demonstrated, can be obtained by double-working. **"This practice may readily be put in operation by purchasing one year old whips of the varieties Hiberna, Virginia Crab, or Antonovka, which have been propagated on hardy seedling root stocks like Antonovka and Anis."* Full information concerning the details of double-working can be obtained from the Horticultural Division, Central Experimental Farm, Ottawa, Canada. Those who do not wish to resort to double-working would be well advised to set out only those varieties of apples which past experiences have shown to be most hardy in their particular districts; second, the importance of following a system of cultivation including sod mulch, and a fertilizer program which keeps the trees strong and vigorous, but allows them to thoroughly ripen their wood before winter; third, the advisability, so far as is possible, of preventing over-bearing by pruning and thinning.

**"Double-Working, A method of building hardier apple trees,"* by D. S. Blair Horticultural Division, Central Experimental Farm, Ottawa, Canada.

TYPES OF WINTER INJURY SEVERE WINTER FREEZING

Severe winter freezing occurred to a disastrous extent to orchards in all the colder parts of the Province in the Winter of 1933-34. Trunks and larger branches were badly damaged, and in numerous instances whole trees were killed. In several cases whole orchards were ruined. Although no careful census was taken, it has been estimated that in New York state a million apple trees were killed and the damage was proportionately great in Ontario.

In the spring of 1934, in many orchards the trees looked normal except that a few here and there had conspicuous cracks in the bark. After the trees were cut into, brown areas were observed in the inner bark and sapwood. Sometimes the sapwood was light brown in colour, but frequently the discoloration was dark brown and extended deep into the wood. In many cases the cambium or growing layer appeared to be less injured than the sapwood. With the advent of warm weather the dark brown areas became water-soaked, often developing an odour like cider, and then in many cases the bark separated readily from the wood in slabs often three or four feet long. This separation of the bark from the wood was most noticeable in the second spring after the freeze. Sometimes the cambium along the edges remained attached to the wood and started a callous formation over the wound. At other times it remained attached to the bark and began a callous formation there. In cases where the sapwood was stained a dark brown all around the trunk or branch the tree or branch showed little or no sign of life in the spring. Many trees, however, which were more or less severely injured grew the first spring after the freeze, but died the following year. They probably had not enough living sapwood left to supply the water and minerals necessary for growth.

Methods of Control: (1) In the parts of the Province where severe winters are likely to occur, care should be taken to set only those varieties which have been shown by experience to be hardy in the particular localities where they are to be grown. In the coldest parts of the Province the practice of Double-Working should provide a means of avoiding severe winter killing in the future.

(2) Keep the trees healthy and thrifty by the proper cultivation or by the use of well-cared-for sod mulch and by the application of fertilizers when necessary to maintain the fertility of the soil. Take care, however, not to over-fertilize or to cultivate so late that the trees will not have their wood and bark hardened for winter. Cultivation in the coldest districts should cease the first week in June. A cover crop should be sown as soon as cultivation is finished.

(3) If winter injury has occurred and the bark has loosened from the trunk, early in the spring see that drainage is provided for the wound, by making a V-shaped cut in the bark at its base. Later in the summer, in July or August, carefully trim away the dead bark and cover the exposed wood with a good water-proofing preparation such as white lead mixed with boiled linseed oil without turpentine, Bordeaux paint, or an approved asphalt preparation.

(4) Bridge grafting, if done promptly, may save many trees with extensive wounds on the trunk. Water-sprouts, if present, or one year old whips planted around the tree may be used for this purpose, the tips of either of these being grafted into the bark above the wound.

(5) Severely winter injured trees should be pruned very lightly; only the dead branches should be cut in most cases.

(6) Good cultivation in the early part of the summer, and careful fertilizing will do much to save weakened trees.

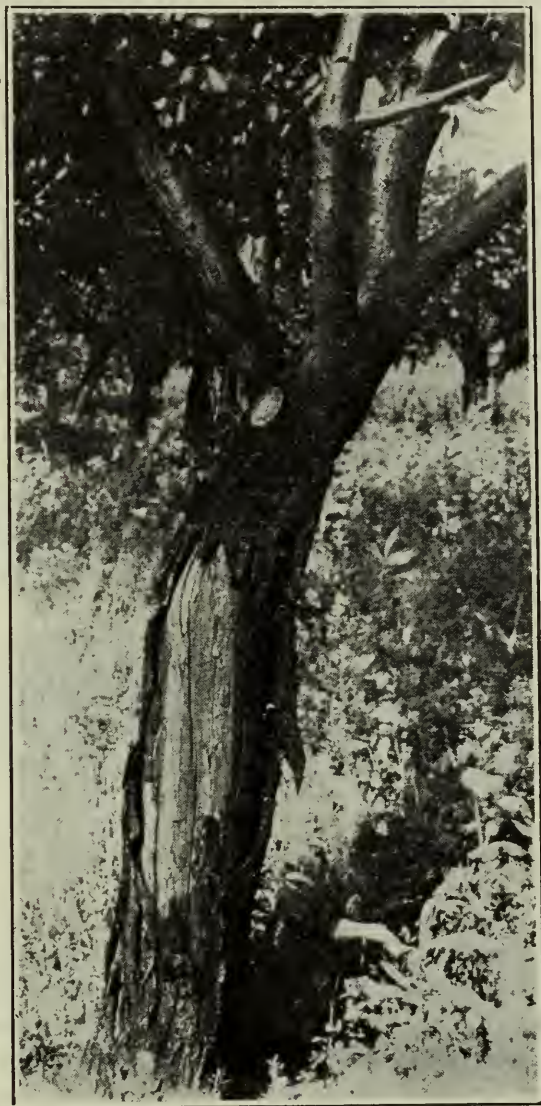
SUN SCALD

This is the most common form of winter injury in Ontario. It occurs all over the Province, but is most severe in the colder portions. Numerous apple, plum and cherry trees in every fruit growing county are affected. The bark on the South or South-West side of the trunk for an area of three or more feet is killed and gradually sloughs off leaving a large open wound. Somewhat similar injuries occur on the upper side of the large branches of apple trees. The most frequent cause of the death of the bark is a rapid temperature fall brought about by its being warmed up by the sun's rays on cold bright days, especially in February and March, and then cooling off very quickly after sunset. This great and rapid drop in temperature is very injurious to the tissues of the bark, and if frequently repeated, kills them. The Sun Scalded areas on apple trees are frequently invaded by the Black Rot fungus, which gradually extends the injuries until in many cases the trunks or branches are girdled, resulting in the death of the tree or larger branches. On plum and cherry trees, Sun Scald is largely confined to the trunks, and here the injury may be increased by fungi or by borers working around the margin of the dead bark. Sun Scalded trees, however, often live for many years and bear almost normal crops.

Methods of Control: (1) When setting out a new orchard incline the trees a little to the South West, and head them low. This helps to shelter the trunks from the sun.

(2) In those sections of the Province where apple trees suffer very severely from Sun Scald only hardy stocks budded with the desirable varieties should be set out. Double-working could be used to great advantage in the coldest parts of the Province.

(3) The trunks may be protected from the sun's rays by various devices such as board trough screens three feet high, and set six inches from the trunk, tacking boards up against the South side of the trunks, or whitewashing the trunks and larger limbs heavily.



Effect of Sunscald on the southwest side of the trunk of a European plum tree. Most of the bark on the injured area has been killed and fallen off. (Original.)

(4) In dehorning and pruning apple trees, never remove all the centre so as to expose the larger branches to the direct sun's rays.

(5) All dead Sun Scalded areas, especially on the trunk, should have the bark trimmed off leaving a V-shaped cut at the bottom, and the wound covered with a non-injurious, water-proofing preparation such as white lead mixed with boiled linseed oil without turpentine, or with any approved asphalt preparation.

CROWN ROT OR COLLAR ROT

This is a form of winter injury which consists in the death of the bark around the base of the trunks of trees. The girdling may be either complete (and in such a case the whole tree soon dies) or it may only be on one side

or portions here and there. In the latter case the branch or branches directly above the dead bark may die, but often the whole top may remain alive and healthy. There is great tendency, however, for these partly girdled trees to become completely girdled after a few years. The Crown Rot is frequently seen in apple orchards throughout the Province, and is by no means limited to the colder districts. King of Tompkins is especially subject to it, but many other varieties also suffer.

There may be several causes for Collar Rot, but the writer is convinced that in Ontario the chief cause is low temperatures acting upon the succulent tissues which have not been properly hardened up for winter. The bark at the crown is much more tender than the bark higher up and hence, when trees have been over fertilized or cultivated too late, this is the part most likely to be killed, especially if not protected by snow. Peach trees and Sweet and Sour Cherries also sometimes suffer from the killing of the bark around the base of the trunk, which is closely allied in nature to Crown Rot or Collar Rot of Apples.

Control: (1) Do not plant on their own stock any variety known to be subject to this type of injury. If these varieties are desired, double-working should be resorted to, or they should be grafted on hardier stocks such as Tolman Sweet, Transcendent or Martha Crab. The King of Tompkins should never be grown on its own stock.

(2) Do not over fertilize or cultivate so late in the season that the trees will not have their wood and bark hardened up for winter. Cultivation should be discontinued early in June. A cover crop should be sown as soon as cultivation is finished. This will help to hold the snow on the ground.

(3) Do not expose the base of the tree by plowing away from it in autumn. There is less danger of Collar Rot under sod mulch than under cultivation.

(4) Where trees are only partially girdled, especially apple tree, it is a good plan to remove the dead bark and trim the base of the wound so as to provide good drainage. Covering the surface of the wound may help to save the tree. It should be covered with a non-injurious water-proofing preparation such as white lead mixed with boiled linseed oil without turpentine, or with any approved asphalt preparation.

(5) If Collar Rot is observed early in the spring after it has taken place, partially girdled trees may be helped by bridge grafting much the same way as suggested for severe winter freezing.

ROOT-KILLING

All kinds of fruit trees are subject to root-killing if growing in light soils, and in situations where the snow blows off and the wind dries out the soil. It is usually brought about by a combination of low temperatures and dry weather which causes excessive evaporation of moisture from the soil. Prolonged cold periods in a winter where there is little snow and little moisture in the ground bring about conditions which cause root-killing especially in light soils. Peaches, cherries and dwarf pears grown on delicate quince roots suffer most, but apples are by no means exempt from this trouble.

Control: (1) Try to maintain a snow covering in the orchard and prevent excessive evaporation from the soil. A good cover crop will do much to

hold the snow. Covering the ground with coarse barnyard manure will help in orchards in which no cover crop has been sown. A hedge for a wind-break may sometimes be planted to advantage to prevent the snow from blowing off.

(2) In setting out new orchards, if possible, secure trees that have been propagated on hardy seedling root stocks.

BARK SPLITTING

Splitting of the bark is seen quite frequently. It is likely to occur in trees that have made luxuriant growth and are not hardened for winter. It seems characteristic of some varieties. At one time it was thought that such trees were "bark bound" or "hide bound". It is now thought to be caused by sudden extreme drops of temperature which cause the sapwood to expand with the result that the bark splits lengthwise in one or more places. Sometimes the split may extend into the wood for some distance but usually only the bark is affected. In some cases the bark is not only split but separated from the wood for an inch or more along one or both sides of the split.

Control: (1) The cultivation and fertilization program should be such as to insure the proper maturing of the tree before cold weather comes. (See under Crown Rot or Collar Rot.)

(2) If the bark is separated from the wood, trim off the loose bark and cover the exposed surface with white lead mixed with boiled linseed oil without turpentine, Bordeaux paint or any approved asphalt preparation. Always open the bottom of the injury so as to provide for the draining away of water. Cracks may be filled with grafting wax or an approved asphalt preparation.

BLACK-HEART

After a cold winter or following sudden extremes of temperature in the fall or early winter, fruit trees may show a condition known as Black-Heart. This is characterized by the centre of the limbs or trunk, the wood and pith, being killed and darkened while the cambium and bark are still alive. Young trees, including nursery stock, are more subject to black-heart than are old trees, but the branches even of old trees may show the trouble. If the injury occurs in the same tree two or three years in succession, or rot-producing fungi get into the wood through a wound, the trunk or branch may become so brittle and weak that any slight strain will cause it to break off. Frequently bearing trees may be black-hearted and live and bear good crops though there is a great tendency for the large branches to die from time to time. Tender varieties of apples and pears are most subject to black-heart. Peach trees sometimes die from this trouble, but owing to the rapidity with which they make new wood are more likely to recover than apples or pears.

Methods of Control: (1) Plant those varieties that experience has shown to be hardy in your district. The experience of the last thirty years indicates that the following are among the most hardy varieties and rarely affected by black-heart: McIntosh, Melba, Duchess, Wealthy, Snow and Wolf River. Spy, Delicious, Baxter, Golden Russet and Tolman are sufficiently hardy in most parts of the Province. Baldwin and King are tender varieties very subject to black-heart. In the extremely cold parts of the Province double-working of apple trees should do much to prevent loss from this trouble.

(2) Avoid over fertilizing and late cultivation, but do not weaken the trees by starvation and neglect. (See under Collar Rot.)

CROTCH-INJURY

In the colder parts of the Province some winters, many trees are injured during the winter at the crotch or forking of the large branches. There is usually a killing of the bark at this point. The tissue here is more tender than on the trunk or branches, apparently not maturing as early as on other points. The less hardy varieties suffer most. Trees that bear a heavy crop of fruit are more liable to this injury the following winter.

After the bark of the crotch has been killed it first takes on a brownish colour and a water soaked appearance, then dries and cracks. If this dead bark is allowed to remain, and there is not good drainage, moisture accumulates and wood rot fungi enter and cause decay at this point. As a result, one or more large branches may break off and the tree be ruined.

Methods of Control: (1) Set out varieties that have proven hardy in the district in which they are to be grown. In the coldest parts of the Province double-working should produce trees with little tendency to this trouble.

(2) When forming the head of young trees distribute the main branches so they will not come out together and thus form a weak crotch. It is a good plan to have a central leader or a semi-central leader.

(3) So far as possible over-bearing should be prevented. Spur pruning and thinning should help.

(4) When crotch-injury has occurred, remove the dead bark and, if possible, provide drainage for the wound and paint the exposed surface with white lead mixed with boiled linseed oil without turpentine, Bordeaux paint, or any approved asphalt preparation.

KILLING BACK OF NEW GROWTH

It is a very common thing, especially after a severe winter, to find that numerous twigs, especially on peaches, have been killed by winter. The killing may extend two feet or more back from the tip. Trees that made a late growth in summer and autumn are usually the ones that suffer most.

Methods of Control — The general principles in regard to cultivation and fertilizing mentioned under Collar Rot apply here. If time permits the dead twigs should be cut out as soon as observed.

KILLING OF FRUIT BUDS

Our tender fruits, especially peaches, have some of their fruit buds killed every winter, while the leaf buds are uninjured. Peach buds are not as hardy as plum and cherry buds. This is the chief reason that peaches require a mild climate. Cherry buds are more often killed than plum buds. Fruit buds of apples and pears are seldom killed.

It is easy to tell if fruit buds are killed. If dead buds are cut through with a sharp knife the centres will be seen to be discoloured. A dead peach bud will have a brown or black centre, and dead plum or cherry buds will have brown pistils.

Bud killing appears to be chiefly caused by a sudden extreme drop or drops of temperature. A mild spell in the winter or early fall may start the buds developing and render them much more susceptible to killing from a sudden extreme drop in temperature.

Control — The presence of a large body of open water by moderating the climate helps to prevent this injury. Apart from the choice of situation and the planting of the hardier varieties, all that one can do would seem to be to follow the well-known good methods of sod culture, cultivation, fertilizing and pruning. Good air circulation is also valuable; hence in choosing a site for an orchard avoid air pits or places where the air circulation may be expected to be poor. Air drainage is almost as important in an orchard as soil drainage.

TYPES OF FROST INJURY

KILLING OF BLOSSOMS AND YOUNG FRUITS

Late frosts during bloom or soon after may destroy numerous blossoms or even young fruits. Sometimes very serious and widespread losses are caused by these late frosts. The amount of injury varies greatly with the stage of the development of the blossoms and the different kinds of fruit. Apple blossoms in the pink stage show some injury when the temperature drops to 25-27° F. The opening blossoms of peaches are injured by temperatures varying from 20-29° F., and those of the cherry by a temperature of 22° F. In full bloom apple blossoms are injured by temperatures of 28-29° F.; peaches in full bloom are injured by a temperature of 27-30° F., and cherries in full bloom by a temperature of 28-30° F. The setting fruit of most fruit trees is injured by a temperature of 28-30° F.*

Blossoms injured by frost have a brown pistil and fail to set fruit. Severely frosted young fruits are killed and drop off the tree. Those less severely injured may become lopsided or marked with bands or patches of russetting.

Control — The choice of a site is important but is often limited. Orchard situations near lakes or other large bodies of water have the best chance of escaping frost injury. Good air drainage is very important. Frost is always more destructive where air drainage is poor. Late blooming varieties such as Spy often escape frost when the blossoms of earlier varieties such as Russet and Greening are killed. In some countries orchard heaters or smudges are used to protect orchards from frost. They have not been tried, however, to any extent in Ontario.

*West, F. L. & Edlefsen, N.E. — Jour. Agr. Research — Vol. XX No. 8.

RUSSETTED AND LOPSIDED FRUITS

Late frosts soon after or as the fruit is setting may result in very conspicuous russet bands around apples and pears. These bands may be at the calyz end, around the middle, or near the stem end.

Severe frosts about the time the apples are setting may cause some of them to be lopsided. The skin on one side is ruptured and one or more carpels killed.

Fortunately both of these types of injury are rare, as there seems to be no practical way to prevent them.

DWARFED AND CRINKLED LEAVES

Frequently in the spring after the buds have opened frost injures or even kills some of the young leaves. Frosted leaves are usually dwarfed and crinkled. They look much like leaves that have been injured by lime sulphur, used for the first two sprays. Sometimes these frosted leaves have the upper surface separated from the lower.

INSECTICIDES AND FUNGICIDES

Liquid Lime Sulphur

The commercial product sold by spray manufacturers is used in most Ontario orchards. Liquid lime sulphur, however, can be made at home by anyone. For directions for making and testing home-made liquid lime sulphur write to the Department of Entomology, Ontario Agricultural College, Guelph, Ontario.

Dry Lime Sulphur

This is a liquid lime sulphur with the water evaporated. Some chemical changes take place during evaporation which influence the effectiveness of dry lime sulphur as a fungicide. It is not recommended for large commercial orchards, but it is a very handy form of lime sulphur for use by the man who has only a few trees he wishes to spray. In using follow the manufacturer's directions.

Lime sulphur is a strong and effective fungicide but unfortunately both liquid lime sulphur and dry lime sulphur have a decided tendency to cause spray injury. This is especially marked in the early sprays if the buds are weak. It also causes burning in the late sprays after the trees are in leaf. This is most serious when it is applied on a hot calm day. Do not use lime sulphur alone on apples in any of the sprays after the foliage has appeared.

Wettable, Bentonite and Ferrox Flotation Sulphurs

These are sold under various trade names. In using, follow the manufacturer's directions. They are not recommended alone for all sprays for Apple Scab, but can be used to great advantage, combined with half strength lime sulphur for certain application, or alone after the Calyx Spray.

Bordeaux Mixture

In Bordeaux mixture formulas the first and second figures express respectively the amount in lbs. of bluestone and hydrated lime and the third figure the amount of water in gals. For example, Bordeaux 3-6-40 means bluestone 3 lbs., hydrated lime 6 lbs., water 40 gals. Lime must be fresh for if left exposed to the air it becomes worthless, so keep it in tightly fastened paper bags in a dry place.

To Prepare Bordeaux Mixture — Nearly fill the tank with water; add the proper amount of dissolved bluestone; start the engine to agitate the liquid; add the lime, and agitate the mixture for about 5 minutes. If a hand outfit is used, agitate by pumping the liquid back upon itself for 5 minutes.

Note — The easiest way to dissolve bluestone in the crystal or lump form is to place 40 lbs. of it in a bag and suspend this in a barrel containing 40 gals. of water in such a way that the bottom of the bag sinks only 4 or 5 inches below the surface. Leave over night and in the morning all will be dissolved. One gallon of the liquid will now contain 1 lb. bluestone.

Small quantities of crystal or lump bluestone can be dissolved rapidly in boiling water by stirring. Powdered bluestone dissolves readily if placed in the desired amount upon a burlap screen on the hopper or inlet of the tank and the water poured over it as the tank is filled.

Dusts

There are two classes of orchard dusts — 1st, finely ground sulphur with and without lead arsenate; 2nd, nicotine dusts. Dusting with sulphur is satisfactory as a supplement to spraying in large orchards, but we do not recommend it as a substitute for the liquid spray. If so used, apply at the same times as indicated for the liquid spray, but in wet weather give extra applications. Dust when air is calm, as late in evening or early in morning.

Lead Arsenate

This is the safest arsenical for orchard foliage with water alone, and the only satisfactory one for codling moth and apple maggot.

Calcium Arsenate (Arsenate of Lime)

Because of its inefficiency against codling moth it should not be applied later than the pink spray. With lime sulphur always add 3 lbs. hydrated lime to 40 gals.

Zinc Sulphate — Lime Mixture

This is used to prevent arsenical injury to peaches, and is prepared as follows:

Formula —

Zinc Sulphate	2 lbs.
Hydrated Lime	2 lbs.
Water	40 gals.

While starting to fill the tank, and with the agitator running, sift in the zinc sulphate gradually and then the lime. When the zinc-lime is thoroughly mixed add lead arsenate and, if necessary, wettable or bentonite sulphur.

Nicotine Sulphate

This is a concentrated extract of tobacco containing 40% of nicotine. It is commonly used at the strength of 1 pt. to 100 gals. of water. The addition of soap, 5 lbs. to every 100 gals. of the spray, increases its spreading and killing properties. If used with lime sulphur the soap should be omitted. Nicotine sulphate should never be applied on a windy day. It is used to kill aphids, pear psylla, white apple leaf hopper and red bug.

Tar Oil Washes

These are used to kill aphid eggs, and are applied only when the buds are dormant. Directions for use are given by manufacturers.

Lubricating Oil Emulsions

These may be combined with Bordeaux or nicotine sulphate, but not with lime sulphur. They are used at strengths of 3% and 4% oil.

Formula—

	3%	4%
Lubricating oil	3 gals.	4 gals.
Bluestone	6 ozs.	8 ozs.
Hydrated lime	6 ozs.	8 ozs.
Water.....	3 gals.	4 gals.

Pour the oil into a container or into the spray tank; dissolve the bluestone in half the amount of water; stir the hydrated lime into the other half; pour these two together, then add them to the oil, and pump this mixture back upon itself through the nozzle under high pressure until all the oil is properly emulsified.

The above amounts of stock emulsion diluted to 100 gals. of water give 3% and 4% oil sprays respectively. Keep agitator running while adding water.

Note:—The lubricating oil must have approximately the following characteristics:

Gravity at 60° F.	24 to 26 A.P.I.
Viscosity at 100° F.....	170 to 200 seconds (Saybolt)
Volatility (loss at 105° - 110° C. after 4 hours.....)	0.41%

Such oil may be purchased from any large oil company.

ACKNOWLEDGMENTS

Much of the information in this bulletin concerning peach yellows and little peach, pear blight and winter injury was supplied by Professor Caesar, who has had many years experience with these troubles in Ontario orchards.



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Ontario Department of Agriculture

TORONTO, ONTARIO

Production of Quality Tomatoes In Eastern Ontario

By

C. E. MIGHTON

Department of Botany

ONTARIO AGRICULTURAL COLLEGE

Guelph - Ontario



Quantity with Quality

Ontario Department of Agriculture

TORONTO, ONTARIO

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Production of Quality Tomatoes in Eastern Ontario

by C. E. MIGHTON

Profitable production of a high quality tomato crop depends on the use of the best practices. Many good growers, by careful attention to the essential points, are securing high yields of good quality tomatoes.

The following recommendations are made as a result of eight years' experimental work and observations in the Eastern Ontario Canning district.

1. Secure seed of good vitality from high producing strains of the most suitable varieties. Tests have shown varieties of the John Baer type (John Baer, Bonny Best and Chalk's Jewel), Scarlet Dawn and Nystate to be satisfactory for this district.
2. Treat the seed for the control of Damping-off. Organic mercury dusts and red copper oxide have been found satisfactory for this purpose.
3. Wherever possible use fresh compost for the seed bed, or as an alternative some form of soil sterilization.
4. Sow the seed five to six weeks before the plants are required for the field. Under normal conditions this allows enough time for the production of a sturdy plant with balance between top and root growth.
5. Transplant only healthy, vigorous seedlings.
6. Protect the young plants from disease by timely and thorough spraying.
 - (a) Spray when the first true leaves are well formed and again four to five days before the plants are to be set in the field.
 - (b) Use red copper oxide. For spraying purposes red copper oxide must be mixed with some material that will keep it in suspension. Such a preparation may be purchased from most seedsmen. When purchasing red copper oxide for spraying be sure to specify that it is to be used for this purpose. This product should be used at the strength recommended by the manufacturer.
 - (c) If red copper oxide cannot be obtained a 2-4-40 Bordeaux mixture may be used. To each 40 gals. of mixture should be added 3 lbs. of resin fish oil soap. Bordeaux mixture is very slightly injurious to tomatoes and for this reason the red copper oxide is preferred. If Bordeaux mixture is used be sure that the plants are well watered before spraying or as soon as the leaves are dry after spraying.
 - (d) Apply the spray at a pressure of 175-200 lbs. Do not hold the nozzle too close to the young plants. If Bordeaux mixture is used be careful to not overspray.

Soil Type.

1. Tomatoes will succeed on a wide range of soil types.
2. The ideal soil is a warm, well drained sandy to clay loam, well supplied with organic matter from barnyard manure or green manuring crops.

Place in Rotation.

1. The tomato crop succeeds best following a crop of clover, sweet clover or alfalfa in a three or four year rotation.
2. Non-legume green manuring crops, such as rye or oats may be used as an alternative to the previously mentioned crops.
3. Whatever rotation is used it should insure the presence of an abundance of organic matter in the soil. An abundant supply of organic matter increases the yield and also improves the quality. It is in addition very valuable in conserving moisture in dry seasons.

Preparation of the Soil.

1. Having planned a suitable rotation, the preparation of the land should be started with the manuring and ploughing of the field in the fall previous to the growing of the crop. A dressing of ten loads of farmyard manure per acre will aid in maintaining the organic content of the soil.
2. Fall ploughing is recommended to bring about earlier decomposition of crop residue.
3. On heavy soils, where late maturity occurs, the manure may be applied to the crop preceding tomatoes.
4. In the spring the land should be worked thoroughly to ensure best conditions of temperature, moisture and fertility. Thorough preparation of the soil before planting is more important than subsequent cultivation.

Planting.

1. Set out only healthy, vigorous plants, avoiding the tall spindley type of growth.
2. A planting distance of 4 ft. x 4 ft. is recommended for the best development of the crop.
3. Set the plants firmly and deeply enough to avoid whipping and breaking by the wind. Care should be taken that the soil is pressed firmly around the roots.

Cultivation.—Cultivation should be frequent and thorough enough to keep down weeds.

1. Start with a deep cultivation. Make each subsequent cultivation shallower and narrower until the cultivator can no longer be driven through the field without injury to the plants. This will avoid the danger of disturbing the root system and interfering with the growth of the plants.
2. Weeds too close to the plant to be removed by cultivation should be removed by hoeing.



(Left—No fertilizer. Right—2-12-10 at 1000 lbs. per acre)

FERTILIZERS

The use of commercial fertilizers as a supplement to crop rotation, barnyard manure and green manuring crops, is essential to the production of good yields of high quality tomatoes.

Recommendations for the Use of Fertilizers.

1. Soil Type—Sandy to light sandy loam—
 - a. A 2-12-10 analysis, at the rate of 500-1000 lbs. per acre is recommended.
 - b. If there has been no clover or manure previous to the tomato crop, supplement the fertilizer application with a 200 lb. per acre side dressing of nitrate of soda or sulphate of ammonia two weeks to one month after planting.
2. Soil Type—Heavy sand loams to clay loams—
 - a. A 2-12-6 analysis at the rate of 500-1000 lbs. per acre is recommended.
 - b. If there has been no clover or manure previous to the tomato crop, supplement the fertilizer application with a 200 lbs. per acre side dressing of nitrate of soda or sulphate of ammonia, two weeks to one month after planting.

Method of Application.

1. The fertilizer should be localized around the plant rather than broadcast.
2. If the necessary machinery is available the band method of application of fertilizer is best.
3. When the fertilizer is applied by hand the best method is to drop it about four inches to one side of the mark previous to setting

it and turn it under with a shovel. Care should be taken that the plant does not come into contact with the fertilizer when it is set or burning may result.

4. The fertilizer may also be applied in a small ring around the plant after setting and hoed into the soil. This method, however, is not as satisfactory as the previous method, particularly in dry years.



(Left—2-12-6 at 1000 lbs. per acre. Right—No fertilizer)

The Use of the Correct Fertilizers is Profitable.

From the experimental work of the past eight years, three average examples of the profits derived from the use of the fertilizers are given

1. Plot on good clay loam in Port Hope district, following a crop of clover fall ploughed and manured in the spring.

Marketable yield on plot fertilized with 2-12-6	
@ 1000 lbs. per acre	478 bus. per acre
Marketable yield on plot not fertilized	328 bus. per acre
Increase	150 bus. per acre
Value of increase at 25c per bu.	\$37.50 per acre
Cost of fertilizer at \$30.00 per ton	\$15.00 per acre
Net profit from use of fertilizer	\$22.50 per acre

2. Plot on sandy loam soil in Brighton district, following a crop of clover manured and ploughed in the fall.

Marketable yield on plot fertilized with 2-12-10	
@ 1000 lbs. per acre	372 bus. per acre
Marketable yield on plot not fertilized	279 bus. per acre
Increase	93 bus. per acre

Value of increase at 25c per bu.	\$23.25 per acre
Cost of fertilizer at \$32.00 per ton	\$16.00 per acre
Net profit from use of fertilizer	\$ 7.25 per acre

3. Plot on good clay loam in Prince Edward County, following a crop of fall wheat with no manure.

Marketable yield from plot fertilized with 2-12-6 @ 1000 lbs. per acre	640 bus. per acre
Marketable yield from plot not fertilized	300 bus. per acre
Increase	340 bus. per acre
Value of increase at 25c per bu.	\$85.00 per acre
Cost of fertilizer at \$30.00 per ton	\$15.00 per acre
Net profit from use of fertilizer	\$70.00 per acre

The above plots have been selected to represent as closely as possible the conditions in the districts mentioned. The marketable yields presented are actual yields containing only smooth, sound fruits, 2½ inches or over in diameter and grading No. 1 or No. 2.

CONTROL OF INSECTS

Cutworms—may be effectively controlled by the use of poison bran baits thereby reducing the cost and labour of resetting the tomato field.

Use—Bran	25 lbs.
Paris Green	1 lb.
Cheap molasses	½ gal.
Water enough to moisten.	

Mix the bran and poison thoroughly and then add the water and molasses. Apply in the evening of a warm night for best results.

Green Tomato Worm—This worm has caused considerable damage from time to time in the past few years. It was very bad in some fields in 1938. The essential point in the control of this insect is in getting the spray or dust on the plants while the worms are still young. Close examination of the plants is required to mark the beginning of the feeding activities. The spray or dust should be applied as soon as the worms are noticed.

1. Dust with the following mixture when the worms are small :
Arsenate of Lime or Arsenate of Leaf ... 50% by weight
Hydrated Lime 50% by weight

OR

2. Spray using a mixture of :
2½ lbs. Arsenate of Lead.
40 gals. of water.

As the worms increase in size they become more difficult to kill with poisons.

Where the necessary help is available, hand picking will aid in keeping the worms under control. Do not destroy worms covered with small white spindle-shaped cocoons of parasite.

For more detailed information concerning the control of these insects consult Ontario Bulletin 393—"Insects Attacking Vegetables".



(Tomato field defoliated by Green Tomato Worm)

CONTROL OF DISEASE IN THE FIELD

1. The results of our experiments to date have not shown spraying in the field to be a profitable practice.
2. Frame spraying does not protect the plants from disease attacks late in the season. Plants sprayed in the frame have, however consistently produced larger yields than unsprayed plants.
3. Leather or Yellow End, which has been one of the most serious causes of loss to the tomato grower, can be appreciably reduced by the following procedures:
 - (a) Use a good crop rotation supplemented by liberal applications of commercial fertilizer. Where Leather End is particularly troublesome use at least ten per cent. potash.
 - (b) Adoption of any measures which will assist in the conservation of the soil moisture, thus promoting strong vine growth.
 - (c) Selection of the varieties and strains which appear to be less seriously affected by the disease. The varieties, John Baer, Bonny Best and Chalk's Jewel have been found to be less affected than the earlier varieties such as Earliana and Break O'Day.

PICKING TOMATOES

Careful attention to colour and maturity at the time of picking is an important point in the production of a quality crop. Careful picking will repay the grower by securing higher grades at the factory.

Growers are urged to take advantage of the special facilities made available for their assistance by the Department of Agriculture through the Ontario Agricultural College and the Agricultural Representatives.

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Ontario Department of Agriculture

TORONTO, ONTARIO

Painting on the Farm

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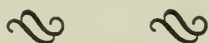
PAINTING ON THE FARM

By

E. W. Kendall, B.S.A.,

PAINTING ON THE FARM

BY E. W. KENDALL, B.S.A., ASSOCIATE PROFESSOR IN
AGRICULTURAL ENGINEERING.



INTRODUCTION

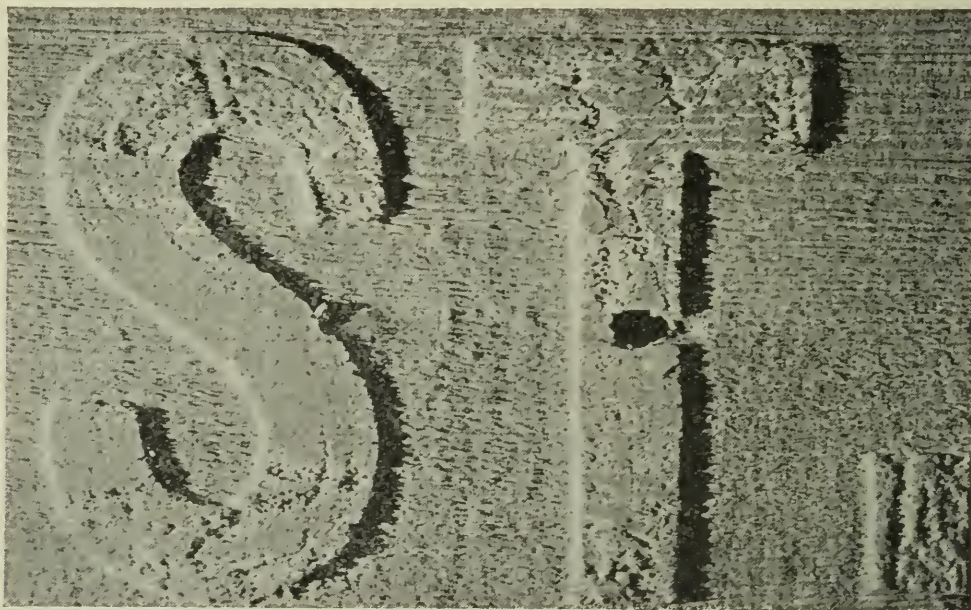
Color has always exerted a profound influence on mankind and he has used it in many ways and for many purposes. Ages before the dawn of history he applied it to his person, either to frighten his enemies or in an attempt to make himself more attractive. Perhaps man's first use of paint on his buildings was for the purpose of decoration but as the years passed its protective value was recognized. In modern times we use paint for these very same reasons but we probably place the greatest stress upon the fact that paint protects and so more than doubles the life of an object to which it is applied. Its value from the decorative standpoint is twofold, in that it not only gives the owner a sense of satisfaction and fulfills his craving for the beauty of color but it adds to the value of his possessions by making them appeal to others in a similar fashion. There is no doubt at all, but that the farm with the well painted buildings is going to sell far quicker and for a higher price than is the one where paint has not been used.

It is undoubtedly true, that neglect to paint is caused by the fact that the job and its cost look so formidable. A farmer may hesitate to attempt it himself owing to his lack of knowledge of paint and it will be the object of this bulletin to attempt to throw a little light on the subject. There is no good reason why an owner may not do a considerable amount of painting himself as time permits, but should he wish to turn the job over to a painter, he has a choice of two methods, the more common one of brush painting or the more modern and less costly one of spray painting. The latter method has many advantages. The paint is forced into the cracks and crevices that could not be filled by brushing methods. The surface is left more even than after a brush and the time taken to do the job is many times shorter. In Ontario there are several companies that will spray paint a group of buildings in a remarkably short time and at a very reasonable cost.

CHARACTERISTICS OF A GOOD PAINT.—A good paint will not be quickly affected by weather changes, once it has properly dried. It will stand considerable wear and is not affected by the ordinary expansion and contraction of the surfaces to which it has been applied. The color will be fairly permanent.

LIFE OF PAINT.—Paint that has been applied to interiors or protected situations will last for many years. Outside paint has an average life of from three to five years, depending upon the quality of the paint, conditions of the weather and surface at the time of painting and the exposure. It is by no means uncommon however, to find painted surfaces in good condition that are seven to ten years old.

WHEN TO PAINT.—Many people favor the fall rather than the spring for painting time. The reasons given are, that the painter is less rushed and will do a better job, that the weather is nearer the proper temperature, 70°F, and that there is less chance of sudden storms. To this might be added the facts that there are



A street sign many years old. The paint has protected the letters S and T, while the unprotected wood has worn away.

fewer insects flying around and that the warm days and cool nights help to harden the paint film.

COMPOSITION OF PAINT.—Paint consists of a solid portion called the pigment, suspended in a liquid portion called the vehicle. When the liquid oxidizes and dries it becomes hard and helps to hold the pigment securely to the surface to which it has been applied.

PIGMENTS.—Pigments may be divided into three classes.

1. Color pigments which impart a color or tint to the paint.
2. Body pigments, such as white and red lead, which gives the paint its lasting qualities.
3. Extenders or pigments which are added to reinforce the paint film or to simply aid in producing a cheap paint.

Principal Pigment Color Classes.

White :— White lead, Zinc oxide, Lithopone.

Black :— Lampblack, Carbon black, Bone black, Ivory or Drop black.

Red :— Red lead, Red iron oxides such as Indian red, Turkey red and Venetian red.

Yellow :—Chrome yellow and Yellow ochre.

Blue :— Prussian blue, Ultramarine blue, Cobalt blue.

Brown :—Raw and Burnt sienna, Raw and Burnt umber, Vandyke brown and Iron oxide brown.

Green :— Chrome greens.

The white pigments are most commonly sold in a paste form, ground in oil. Cans or kegs holding from $\frac{1}{2}$ lb. up to 100 lbs. may be bought. Lithopone is an exception to this in that it is usually sold under a trade name as a ready mixed paint.



Painting a roof by spraying.

The tinting pigments are also sold, ground in oil. The containers may be collapsible tubes where small quantities are needed or half to five pound cans for larger quantities.

White Lead is the most commonly used priming paint and in many cases is the only pigment used on a painting job. On account of the fact that its paint film is soft and easily soiled and that it tends to discolor where sulphur is present, it should not be used alone around barns, poultry houses or hog-pens. In these situations about 50% of Zinc oxide is used with the white lead.

Zinc Oxide finds its greatest use in interior paints. It gives them a hard firm coat to which dirt does not readily stick. It is used largely in the manufacture of enamels. Its great qualities are its durability and permanence of color.

Lithopone is extremely opaque and has great spreading qualities and is used in combination with zinc oxide as an inside flat paint. As now made, it is light proof and is used in many outside paints.

Red Lead has its greatest value as a priming coat on iron and steel. Its value lies chiefly in its adherent qualities. On the farm it finds its chief use as a priming coat on galvanized surfaces. It should however be used as a primer only and should always be painted over with a coat of outside paint as by itself it does not stand exposure well.

COLOR PIGMENTS.—Some of these pigments fade very readily and so require frequent renewing. These are Chrome yellows, Chrome greens and Prussian blues. The more permanent pigments are Raw and burnt umber, Raw sienna, Indian and Venetian red, Lampblack, Ivory and Drop black.

PAINT VEHICLES.—The liquid portion of paints may consist of oils, thinners and driers.

PAINT OILS.—Linseed oil is the standard paint oil and may be sold as “boiled” or “raw” oil. It does not dry in the same sense that water will dry or evaporate from a surface but a chemical action takes place in which oxygen of the air combines with the oil to form a tough, elastic skin. As raw oil dries slower than boiled oil, it is almost always used with a drier. When boiled oil is used it is not necessary to use a drier. Ordinarily, boiled oil is used for inside uses and raw oil for outside uses. Always specify “pure linseed oil”.

THINNERS.—Turpentine is the most commonly used thinner. It serves various purposes, such as increasing the spread of the pigment, causing the paint to dry quickly and assisting the paint to penetrate the surface to which it is applied. Turpentine substitutes are special petroleum products with a distillation range about the same as turpentine. They are generally used either alone or mixed with turpentine.

DRIERS.—Brown Japan or Japan Drier quickens the action of the drying or hardening of the paint film and is always used when raw linseed oil is a vehicle. They must not be used in excess, however, as rapid deterioration of the paint film will result.

Paint Brushes

To do good painting one needs good brushes as well as good paint. Good brushes are expensive but if given the proper care will outlast several cheap brushes and at the same time do much better work.

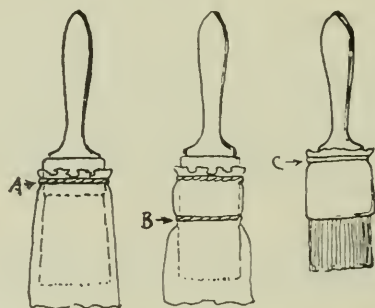


Fig. 1. Bridling Brushes.

It is generally conceded that the best size of a brush for the bigger jobs is a round brush about 2" diameter with 6" bristles. This brush will have to be “bridled” and an easy method is by use of a piece of cloth. This is wound around the brush

and tied firmly to the ferrule as in fig. 1A. A second cord is now wound around cloth and brush about 3" below the top of the bristles as in fig. 1B. The loose part of this sleeve is now turned back over the cord B and bound tightly to the ferrule above A, fig. 1 at C.

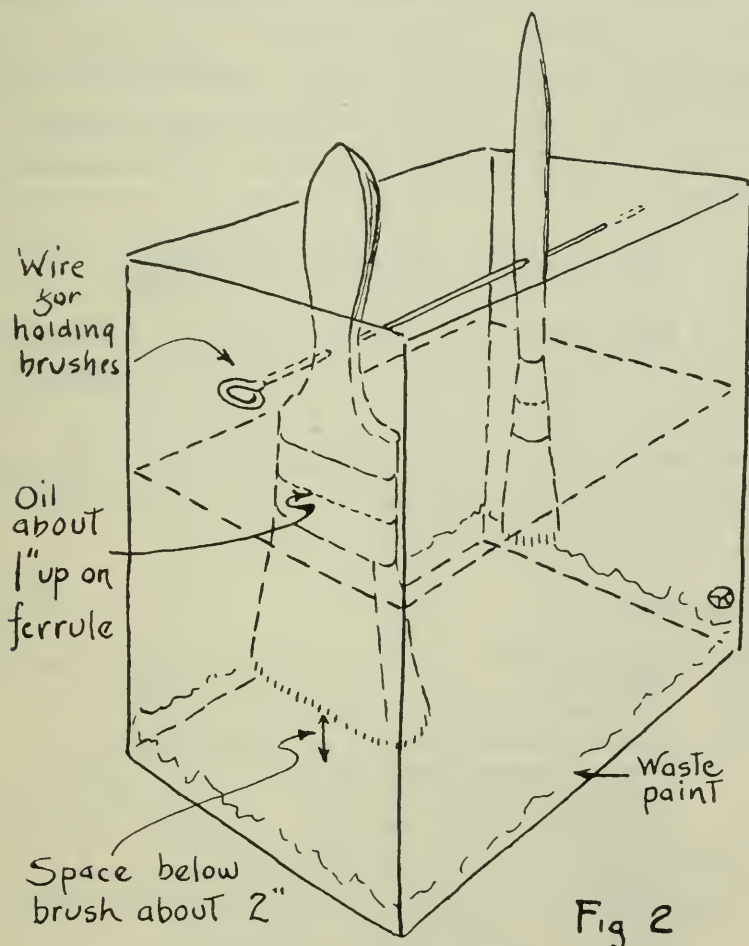
Flat brushes are the most generally useful especially where speed is necessary. For working around window sash a special brush is often used.

CARE OF BRUSHES.

On buying:—Shake out all dust, rinse in turpentine and hang up to dry in a dustless place. When dry, wrap in paper and place flat on a shelf.

While in use:—Dip about an inch only into the paint, slap the brush against inside of can and do not drag it too heavily over the sharp edge. This sets the paint into the brush and helps prevent dripping. Hold brush with fingers well down on the ferrule and keep it approximately at right angles to the surface being painted. A brush should not be left standing on its bristles, for any length of time.

On stopping work for a short time:—Work out most of the paint and wrap the brush up in paper. Place where it will lie flat.



Wet storage of brushes.

On storing wet:—Special covered boxes may be bought or a substitute made. Hang the brushes in these so that the bristles are at least one inch above the bottom and so that the oil comes part way up on the ferrule. As paint will settle out into the box you must empty it out occasionally.

Varnish Brushes are suspended in varnish and cleaned with turpentine. Shellac Brushes are suspended in air tight containers in shellac and are cleaned with alcohol. Bronzing brushes are cleaned with gasoline immediately after use. If brushes are left in water they will become soft and lose their spring.

On storing dry:—Clean with turpentine. Wash in soapy water and rinse out all soap.

Give a final rinse in alcohol and when dry wrap in paper. Hang up or store flat on a shelf.

Cheap brushes that have become hardened with paint may be cleaned and softened by boiling in vinegar. Good brushes may have hardened paint removed by soaking in paint remover. They should not be allowed to remain in the paint remover too long or they will soften up and become useless.

Estimating the Surface to be Covered

Before buying paints it is necessary to estimate the area to be painted. This may be done by considering each surface of the building as a separate unit and not taking into account any openings. Walls would be rectangular units and you find the area by multiplying the length by the height. Gables are triangular units and you multiply the length by one half the height to get the area. Adding all the products thus obtained will give you the total area. The examples will show how this is done. See Page 7.

Spreading Capacity of Paints

This varies very much according to the consistency of the paint, its color, the character and color of the surface to be covered, and the method of applying the paint, dipping, brushing or spraying.

Spreading capacity depends largely on composition. A cheap paint will not cover nearly as much surface as a good one.

The following may be used as a guide.

Surface		Square feet covered by 1 gallon
1. Wood.	—new— Priming coat -----	420
	2nd coat -----	500
	3rd coat -----	720
	—old— weather beaten and not previously painted ---	300
	new paint same color as old -----	720
	new paint lighter than old -----	500
	new paint darker than old -----	750
2. Concrete.	smooth -----	360
	rough -----	240
3. Brick.	hard -----	480
	soft -----	420
Metal such as galvanized iron -----		800

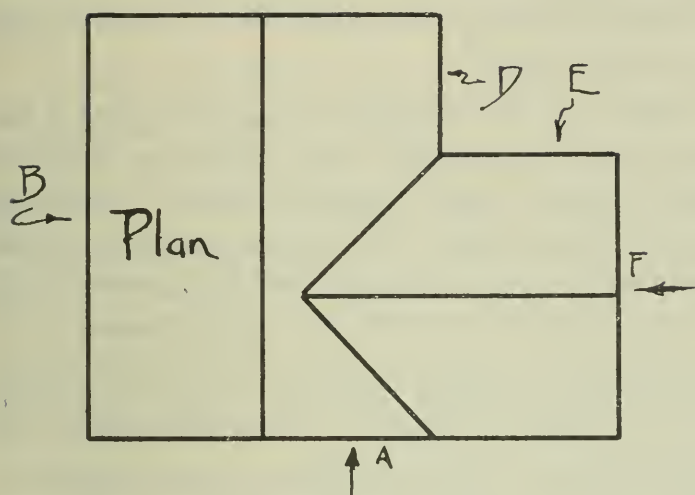
Shingles—dipped in stain $\frac{2}{3}$ length require $2\frac{1}{2}$ gallons of stain per 1000 shingles.

Covering capacity of varnish and shellac would be about as follows

Varnish. 1 gallon would cover 540 sq. ft.

Shellac. 1 gallon would cover 720 sq. ft.

Estimating Areas to be Painted. House with wing.



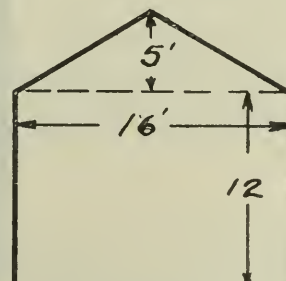
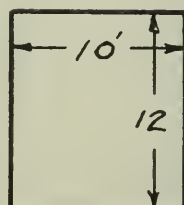
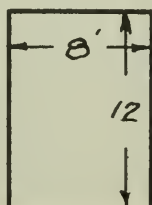
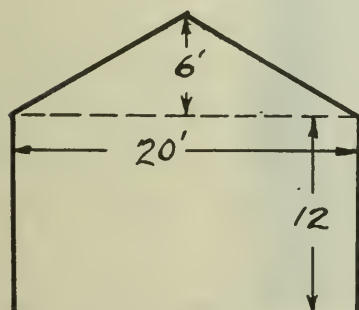
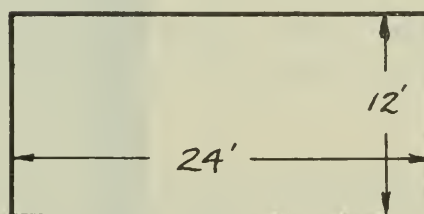
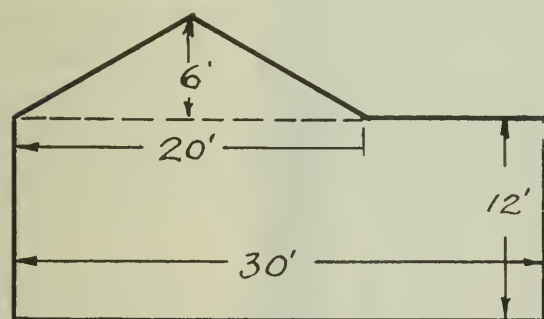
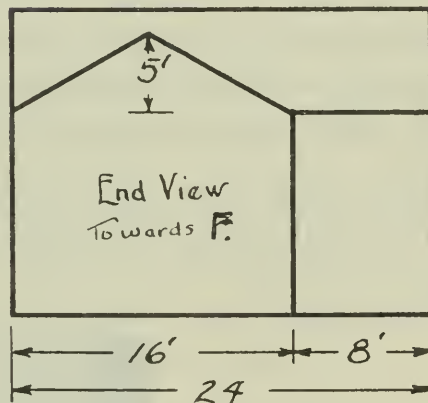
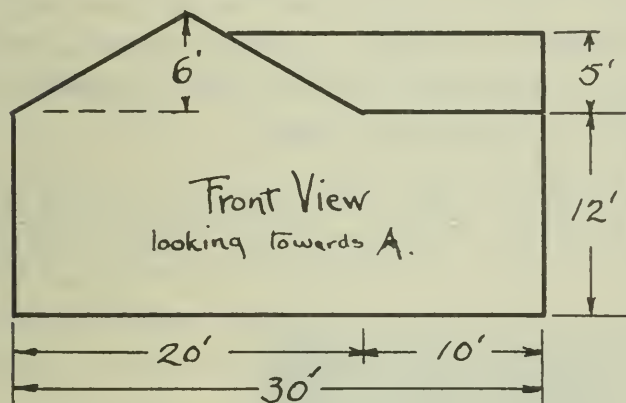
Rectangles.

A	$30 \times 12 = 360$	sq. ft.
B	$24 \times 12 = 288$	" "
C	$20 \times 12 = 240$	" "
D	$8 \times 12 = 96$	" "
E	$10 \times 12 = 120$	" "
F	$16 \times 12 = 192$	" "

Triangles on

A	$20 \times \frac{1}{2} \times 6 = 60$	" "
C	$20 \times \frac{1}{2} \times 6 = 60$	" "
F	$16 \times \frac{1}{2} \times 5 = 40$	" "

Total Area. 1556 sq. ft.



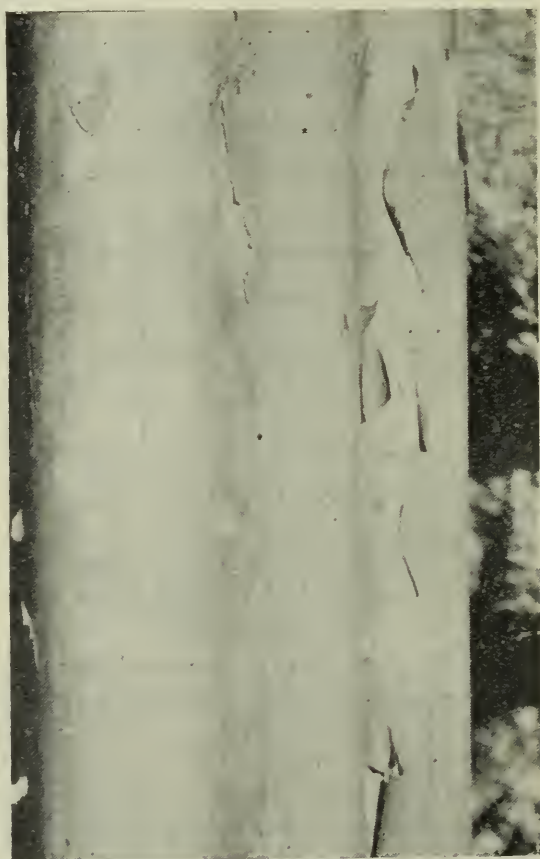
Preparation of the Surface to be Painted

A good painter is always particular about the condition of the surface to which he applies his paint and an amateur should be even more particular. The following treatment of surfaces cannot be too strongly urged.

New Wood Surfaces.—Paint adheres to wood largely through the hold it obtains on the tiny pores or openings in the wood surface and if these are filled up with dust, water, sap, resin or grease, the paint will eventually scale off. That being the case, new wood should be dusted off, knots painted with shellac and grease spots washed with benzine. Woods that are extremely resinous are first treated with paint thinned with turpentine and cypress used in greenhouses, with benzole.

Old Painted Surfaces.—If the surface is in good condition it may be washed, dried, lightly sanded and dusted. If the surface is scaling, a thorough scraping and brushing with wire brushes may be necessary. If this scaling is due to dampness, the cause must be removed. If due to resin, scrape the surface and treat with paint thinned with turpentine. In some cases the old paint is completely removed with a blow-torch or a paint removing liquid. The blow-torch is generally used for out of doors. This removal results in a better surface appearance.

Metal Surfaces.—Cleaning methods for metal surfaces are much the same as for wood. All loose dirt must be removed. This is especially true of rust. Many people are tempted to paint right over rust and are disagreeably surprised when in



Paint peeling off a new galvanized iron downspout that has not been treated previous to painting.

a year or so the rust begins to show through the paint. When this happens, both paint and rust have to be removed to make a job. Rust may be removed by scrapers made from old files. This scraping is followed by a brushing with a wire brush until the metal is as clean as it is possible to make it.

A new galvanized iron roof should be examined carefully every six months and painting postponed until the first signs of rust appear. If painted at this time it will be possible to avoid a lot of hard work as the surface will need no special preparation except dusting. Paint will not adhere to new galvanized surfaces without special preparation. Four ounces of copper sulphate are dissolved in a gallon of water. This is applied with a large brush and allowed to dry thoroughly. Another method is to wash the surface with gasoline. It should be noted that no special preparation is necessary after the surface has been exposed to the weather for a year or two. In any case the surface to be painted must be perfectly clean.

Old Concrete surfaces.—These simply require dusting with a stiff brush.

New Concrete Surfaces.—Surfaces less than a year old should be brushed over with a solution of 4 lbs. of Zinc Sulphate in one gallon of water. This treatment is used on new brick and plaster surfaces also. If there is a whitish coating on the brick—usually found below the windows—it will have to be removed by brushing with a solution consisting of one part of Hydrochloric Acid in five parts of water. After this treatment the wall must be well washed down to remove the acid.

Interior Plaster Walls.—If walls are new they will have to be treated with Zinc Sulphate as noted above, but after one year this will not be necessary.

If walls are dirty they will have to be washed. To do this prepare a warm solution in which some ivory or linseed oil soap is used along with a little washing soda, a handful of flour and some powdered glue, just enough to make the solution slightly sticky when rubbed between finger and thumb. Put this on one side wall with a whitewash brush and allow it to stand a couple of minutes. Now wash off the whole wall with clean warm water. Be careful to protect floor and baseboard or the dirty water may stain them.

Old wall paper may be removed by soaking it with a warm solution of very thin flour paste and when the paper is softened, scrape all off with a broad-bladed scraper. Then wash the whole wall with warm water containing some washing soda.

Large holes in the plaster should be cleaned out down to the lath, the edge of good plaster slightly undercut and the hole filled in with one of the prepared plasters. Dampen the edge of the hole and the lath before applying the new plaster. Cracks may be filled with a mixture of Plaster Paris and hydrated lime made into a putty by adding a little water.

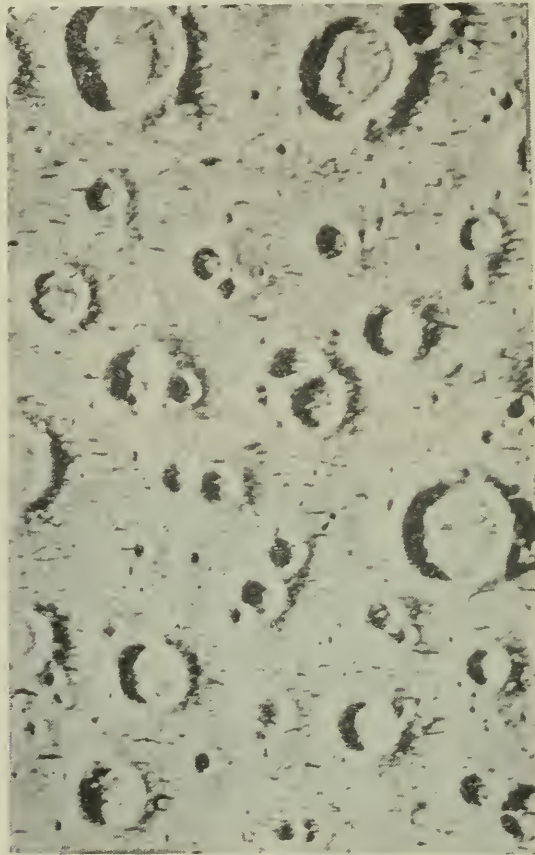
Small cracks may be filled by making a white lead putty and working it into the cracks with a putty knife. This putty is made by using white lead paste with a little powdered whiting. If it gets too stiff, add a few drops of linseed oil.

If walls are inclined to be porous a varnish size made of 1 part varnish to 1 part turpentine, to which a little of the paint has been added to offset the brown of the varnish, may be applied after the priming coat has been put on.

Walls to be calcimined are usually given a coat of glue size. This is made by soaking glue over night in enough water to cover it. In the morning this is heated to almost the boiling point and hot water added. It should be made very thin.

Home Mixed vs. Factory Mixed Paints

When you have decided to paint, the question of mixing your own paint or of buying a factory product is bound to come up. Time and again you will hear people condemn a ready mixed paint. It should be understood that a reliable manufacturer,



Spotted effect produced by rain falling on a newly painted surface. (Enlarged)

who has a reputation to keep up, can and will turn out a better product than you can make at home. This is especially true of paints for special purposes, as he has access to materials that the ordinary buyer cannot obtain. Furthermore it would be impossible to blend some of these paints at home. One of the advantages of a good mixed paint is that you can figure closer on any particular color whereas if you mix it yourself you will always have to make plenty for fear you would run short and have the difficulty of mixing and getting a good match.

You will pay more for a good mixed paint but in the long run it will prove the cheaper buy. While it is true that the package cost is invariably greater, the square-foot cost represented by the performance of the product is usually the same or less.

For example, on actual experiments it has been found that a high quality paint will in every respect match the performance of a properly made lead and oil paint mixed by hand, but in addition will spread over a greater surface. In other cases tests have proved that one quart of a quality product made by machinery will go as far as two quarts of an improperly made or inferior paint,—so that on a square-foot basis, regardless of package cost, a high quality paint is invariably more economical.

No matter how good a mixed paint or any other paint is, if it is applied under unfavorable conditions of surface or weather, it should not be expected to give the service that it will when conditions are right. Dryness is a prime requisite and a temperature around 70°F is about right. Painting too soon after a rain will result in peeling and when rain falls on a freshly painted surface it will wash off some of the paint and give a spotted appearance.

Preparation of Ready Mixed Paints

1. Provide a clean empty can, a little larger than the one the paint is in. An old paint tin can be cleaned by taking it out of doors, pouring a little gasoline into it, sticking a wad of paper in and setting fire to the paper. Place the can on its side and roll it back and forwards as the paint burns. Wipe it out clean.

2. Open the can of paint and pour off almost all of the liquid into the clean can.

3. Stir the remaining paint with a smooth paddle until it is of even consistency and all is free from the sides and bottom of the can.

4. Add about a quarter of the liquid that you poured off and mix it until the consistency is even again.

5. Repeat this until the liquid has all been worked in.

6. Pour the paint back and forth from one can to the other several times.

As this paint is now of the right consistency for a final coat, you will have to thin it for the priming and second coats. If there are no directions on the can the following may be used.

For priming coat add $\frac{2}{3}$ cup of Turpentine and $2\frac{2}{3}$ cups of linseed oil to each quart of mixed paint.

For the second coat add 1 cup Turpentine and $\frac{1}{4}$ cup of linseed oil to each quart.

Mixed paints for almost any special purpose may now be obtained and it is best not to use them for any purpose except for that for which they are specified.

Home-Mixed Paints

If you are going to mix your own paint it will be necessary to have some containers. Cans that can be made air-tight are excellent, as they keep hard films from forming on the paint.

Some smooth, strong wooden paddles for stirring are necessary.

A small screen with some cheese cloth for straining the paint through.

White lead of a good quality, pure raw linseed oil, pure turpentine and Japan drier are the principal ingredients used.

A good mixing procedure would be as follows:—

Measure and weigh out the ingredients according to the formula given later. This is very important and should be done carefully if you are to know where you are at.

Put the lead into a large container that has been wetted with some linseed oil. Add about a cup of oil and cut the oil into the lead with a paddle. Cut and stir the lead till all the oil has been worked in and you have an even paste. Add more oil and work it in as before. When about half of the oil has been worked in you should add the tinting material. This tinting material is usually in the form of an oil paste and a little of it should be mixed to a thin cream with a little turpentine. Add some of this to your white lead mixture and stir it in well. When all streaks have disappeared and if the color is strong enough test it out by putting a daub on a piece of clean glass. Examine the color from the other side. If the color is right, put this piece of glass away to dry and you can use it if you have to make a match of the same color. When all the tinting material is in, add the brown japan and the rest of the oil. Last of all work in the turpentine. Allow the batch to stand over night and strain through a thickness of cheese cloth placed over a piece of wire fly screen.

Standard White Lead Paints.

New Unpainted Wood Outside.

	1st Coat	2nd Coat	3rd Coat
White Lead Paste -----	120 lbs.	120 lbs.	120 lbs.
Pure Raw Linseed Oil -----	5 gals.	4 gals.	3½-4½ gals.
Pure Turpentine -----	1 gal.	¾ gal.	1 quart
Japan Drier -----	1 quart	1½ pints	1½ pints
Gallons produced -----	9 gallons	7¾ gals.	6¾-7¾ gals.

Old Painted Wood Outside.

White Lead Paste -----	120 lbs.	120 lbs.	120 lbs.
Pure Raw Linseed Oil -----	4 gals.	4 gals.	3½-4½ gals.
Pure Turpentine -----	1 gal.	¾ gal.	1 quart
Japan Drier -----	1½ pints	1½ pints	1½ pints
Gallons produced -----	8 gallons	7¾ gallons	6¾-7¾ gals.

New Wood Inside.

			Gloss	Flat
White Lead Paste -----	120 lbs.	60 lbs.	60 lbs.	60 lbs.
Zinc Oxide Paste -----	0	60 lbs.	60 lbs.	60 lbs.
Pure Raw Linseed Oil -----	1 gal.	1¾ gal.	3½ gals.	—
Pure Turpentine -----	3 gals.	1¾ gal.	1¼ gals.	2¾ gals.
Japan Drier -----	1 pint	1 pint	1 pint	¾ pint

Unpainted Plaster New.

White Lead Paste -----	120 lbs.	120 lbs.	-----
Pure Boiled Linseed Oil -----	5 gals.	1½ gals.	-----
Pure Turpentine -----	1 gal.	1½ gals.	-----

Note:—In place of a white lead primer a Varnish size is often used.

Unpainted Plaster (new) 3rd Coat.

	Flat Finish	Egg Shell Finish	Gloss Finish
White Lead Paste -----	120 lbs.	120 lbs.	120 lbs.
Pure Boiled Oil -----	0	1 gal.	4½ gals.
Pure Turpentine -----	3 gals.	2 gals.	1 pint
Gallons produced -----	5½ gals.	5½ gals.	7½ gals.

Metal Work.

	1st Coat	2nd Coat	3rd Coat
Red Lead Powder -----	36 lbs.	34 lbs.	Same as for
Raw Oil -----	⅔ gal.	⅔ gal.	unpainted
Boiled Oil -----	⅓ gal.	⅓ gal.	plaster
Turpentine -----	½ pint	½ pint	under all
Lamp Black ground in oil -----	0	6 oz.	conditions.

Aluminum Finish on Metal

Aluminum Bronze -----	2¼ lbs.
Spar Varnish -----	7 pints
Turpentine -----	1 pint

Radiators for Steam and Hot Water.

Priming coat may be of Aluminum Bronze.

Next coat or coats as for New Wood (inside).

Never use Aluminum or Copper Bronze for a finishing coat as they will cut down the amount of heat radiated by from 15 to 25%.

White gloss enamel gives the best result.

Porch Floors, Waggon and Agricultural Implements.

	Priming Coat	2nd Coat	3rd Coat
White Lead Paste -----	15 lbs.	11¼ lbs.	11¼ lbs.
Zinc Oxide Paste -----	0	3¾ lbs.	3¾ lbs.
Boiled Linseed Oil -----	1½ pints	0	3 pints
Turpentine -----	4 pints	3 pints	¼ pint } mix
Spar Varnish -----			1 pint } first

Tinting color ground in oil added to 2nd and 3rd coats.

Shingle Stain.

Raw Linseed Oil -----	1 gal.
Coal-tar Creosote Oil -----	2 qts.
Japan Drier -----	1 qt.

Tinting color ground in oil added to this to get the desired color.

A cheap brown stain may be made by using black asphaltum varnish and thinning it with kerosene until you get the shade of brown you wish to use. Shingles are stained by brushing or dipping. The best way is to dip the shingles first and then give them a brush coat after the roof is finished.

To dip shingles you will need a tub to hold the solution and a galvanized iron trough for draining them on. The drip from the shingles will run into the trough and back to the tub. Dip a number of shingles at a time into the stain for about two-thirds their length. Remove them immediately and stand them in the trough. When they have stopped dripping, scatter in a broad pile to dry before putting them on the roof. In working with stains containing creosote it is well to cover the skin of face, neck and arms with a thin coat of vaseline to prevent burning.

Using a Paint Brush

As the final results in painting depend in part upon the way the paint is put on, a few pointers upon the application of paint are given.

The brush should be held with an easy grip in such a way that the tips of the fingers come about half way down on the ferrule. Hold the brush so that it is normally at right angles to the surface. This causes the brush to wear evenly. In painting a ceiling do not dip more than a quarter of the length of the bristles into the paint and set the paint into the brush by slapping it against the inside of the can. Do not press too heavily and hold the brush entirely by the handle. Ordinarily start to lay the paint at the centre of the area you think the brushful will cover. Work the paint in with a rather circular sweep in one direction. "Lay off" by working it at right angles to this direction and finish with the empty brush in a

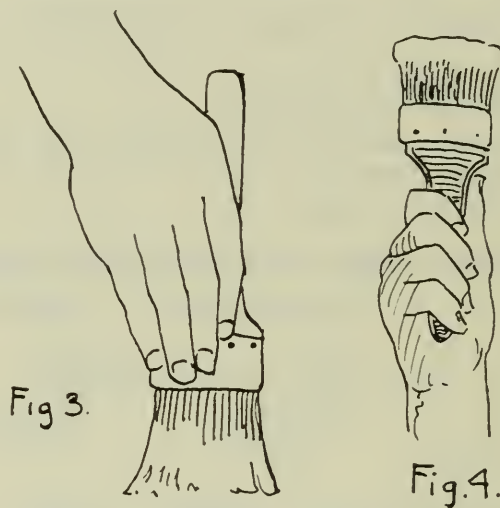


Fig. 3. Holding the brush for average work.

Fig. 4. Holding the brush when painting ceilings.

direction parallel to the length of the strip you are painting. On ceilings take a strip about eighteen inches wide across the narrow length of the room.

On walls, start at the upper left hand corner and work in vertical strips about a foot wide. This allows you to get the second strip on while the first is still wet and so you avoid lapping streaks. When you come to a corridor, do the area above the window first, then a strip about six inches wide on each side of the window, bringing both sides down at the same rate alternately, after which you do the area beneath the window. As you finish a brush stroke do not flip the brush but bring it off gradually to avoid spattering. A clean cloth, very slightly dampened with a little turpentine, should always be at hand to wipe up spatters and drops.

Flat paints are harder to apply as they dry very rapidly and will roughen up if worked over or brushed too much. It is well to work rapidly on rather small areas and avoid all lapping.

Floor Painting

Paint as used for wood trim in a house will not stand up to the hard usage it would get when applied to a floor, so that it is necessary to modify the formula somewhat.

First Coat—This may be an ordinary white lead priming coat. When it is dry all holes and cracks should be puttied. For this purpose procure the very best putty and work into it about ten percent white lead paste. This mixture will give a good hard putty.

Second Coat—Same as for new inside woodwork.

Third Coat—Same as second coat but leave out the turpentine and put in a quart of floor varnish for every gallon of paint. Use only a real good varnish.

Always allow each coat to dry well, 48 hours is none too long and 72 hours would be better.

Varnish

Varnished finishes are used a great deal but one often hears people object, as they say they are too glaring and shining. This gloss can easily be softened by rubbing it with a felt pad and using pumice and water. This, if carefully done, gives a beautiful soft lustre.

For best results in varnishing the temperature should be around 70°F. and the room perfectly free from dust. The first coat may be brushed in a little more than the others. Varnish is always applied in thin coats lengthwise of the grain. If it does not set too rapidly, it may then be cross brushed and laid off lengthwise again with light, quick strokes. The first coat should stand a week before the second is applied, although it may appear quite hard after 24 hours. This hardness is really on the surface only. Before applying the second coat rub the first coat lightly with a number 00 sandpaper. Remove all dust with a "tacky cloth". This is a cloth that has a small amount of varnish squeezed out of it. It will pick up and hold the dust. The second coat may now be applied. Three coats will probably be enough. Sand all but the last coat.

Wood Filler

Before varnishing wood it is often filled. This is especially true of the more porous woods, such as oak, ash and chestnut.

To make Filler:—

Materials—12 parts of pure boiled linseed oil.
6 parts of brown Japan drier.
1 part of pure turpentine.

Mix these liquids thoroughly and work into them enough powdered Silix to make a stiff dough-like mass. Allow this to stand over night. Some of the oil will have come to the top and it should be well worked in. When you are ready to use the filler you will have to thin it with benzine or gasoline to a creamy consistency.

Applying Filler.—Use a fairly stiff brush and work it both with and across the grain, your object being to fill all the pores. Some workmen use a piece of inner tube pulled over a block of wood and with this they press the filler into the pores after brushing it on.

Removing Surplus Filler.—After the filler has lost its gloss (10 to 20 minutes), the surplus filler is rubbed off the surface. Use a 10-inch square of burlap or clean sacking and rub across the grain so as not to lift the filler out of the pores. Clean out corners with a pointed or chisel-shaped stick of wood. Wipe off any remaining filler with a clean cotton cloth. If any of it has become hardened, use a cloth dampened with benzine. Allow to dry for 24 hours and sand lightly with a fine sandpaper. Then dust off and you are ready to varnish.

Varnish on Furniture

For fine effects on furniture, the varnish should be rubbed between coats to remove any bumps, dust particles or thick spots. Use a 00 or 000 sandpaper which has been smoothed a little by rubbing two pieces of it face to face. Go over the hard varnished surface, working with the grain wherever possible and always finishing off with the grain. Dust off with a tacky cloth.

Apply the second coat and allow it to harden. This coat is rubbed with powdered pumice and water, using a thick piece of rubbing felt. Wet the felt pad and dip it into the pumice. Rub with the grain, just sufficiently to partly kill the gloss. It will be necessary to wipe off the pumice occasionally, in order to see that the rubbing is kept uniform. When a uniform dullness has been secured, clean off and dry the surface.

The last coat when thoroughly dried is rubbed with FF pumice as before and when it has been cleaned off, it is given a final rub with a polish made by mixing 1 quart of vinegar, $\frac{1}{2}$ pint of 3 in 1 oil and $\frac{1}{2}$ lb. rotten stone. Shake this well and rub with a circular motion. Clean off with a dry, soft cloth.

Staining Woods

Stains are classed as Oil stains, Spirit stains and Water stains. The beginner will find the oil stains easiest to apply, as they do not become blotchy if you lap back on to a previously stained part.

Wood to be stained must be perfectly clean and smooth and the stain applied rapidly with strokes the full length of the piece if possible. Do the least seen parts first. Work from top to bottom. Wipe up all surplus stain with a clean cloth.

If a water stain is to be used, it will be necessary to raise the grain of the wood first. This is done by sponging the surface with clean water and a sponge, just enough to dampen it. Allow it to dry and then sand off the fuzz that rises up. The surface will have to be covered very rapidly to make sure that there will be no streakiness. If there is any tendency for stain to lie on the surface, pick it off very quickly with the brush, having first rubbed the brush firmly on the edge of the pail or over a paddle to render it partially dry. Speed and lightness of touch are essential.

Lacquers

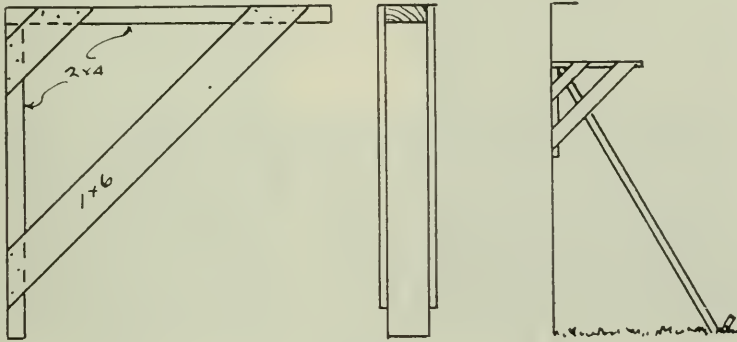
Modern finishes have been developed since the war that are remarkable for their quick-drying properties. They should be applied to the raw wood or over shellac. Subsequent failures almost invariably happens if this is not observed. In applying lacquers use a soft brush and allow about three hours between coats.

Some of the best known colored varnishes may be used in place of lacquer.

Scaffolding

The amount of scaffolding needed is generally determined by the number of men doing the job. Often all that is needed is a ladder or a step-ladder.

A simple type of scaffolding is that in which a right angle bracket is held against the wall by a good brace.



Angle brace.

Another type is made as illustrated in Fig. 6.

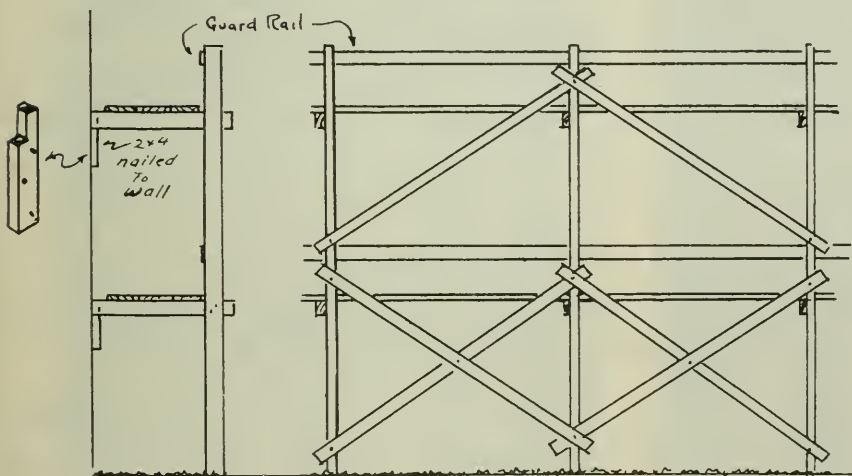


Fig. 6

Scaffolding secured to building at each stage.

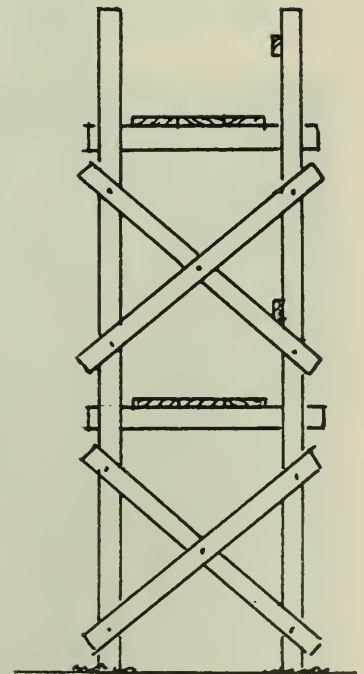


Fig. 7.

Scaffolding independent of building for support.

A third type is made by constructing units of two posts with joists and braces as in Fig. 7. These are constructed on the ground, raised to place and fastened to the building.

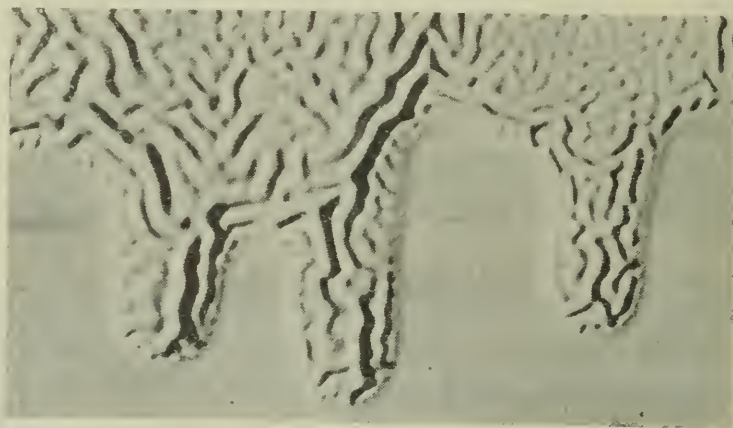
These units are then braced as in Fig. 6.

Scaffolds must be built in such a way as to give the worker confidence in them if he is going to do a good job.

Some Common Paint Troubles

1. *Chalking*.—This is not considered a serious defect, unless it is so bad that it rubs off on the clothes for example. Chalking in moderation is desirable in that it gives an excellent surface for repainting jobs.

Causes:—Probably not enough oil has been used in the priming coat and the wood has absorbed all of it, not leaving enough on the surface to oxidize and form a film to hold the white lead in place. Too much oil must be avoided, of course, and this gives the best of all reasons why one should measure and weigh all the materials used and follow the formulae as given.

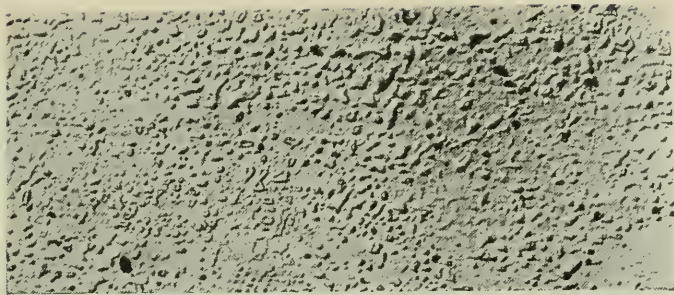


Sagging of paint. The wrinkled film will not wear well.

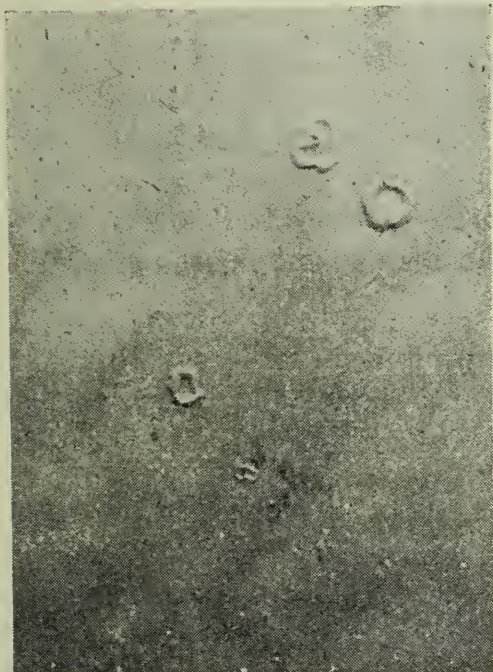
2. *Slow Drying*.—Slow drying may be caused by painting when weather conditions are not favorable, but usually this is due to the use of inferior oils or old oils that have become thick or syrupy. Oil from the bottom of the tank containing sediment called "foots" will also be slow drying. Cold, non-absorbent or damp surfaces tend to slow up drying of paint.

3. *Runs and Sags*.—These may be caused by applying paint too thickly or by using a slow drying paint. Painting over a glossy surface will also result in runs. It is well to kill the gloss by sanding it lightly and then dusting it off.

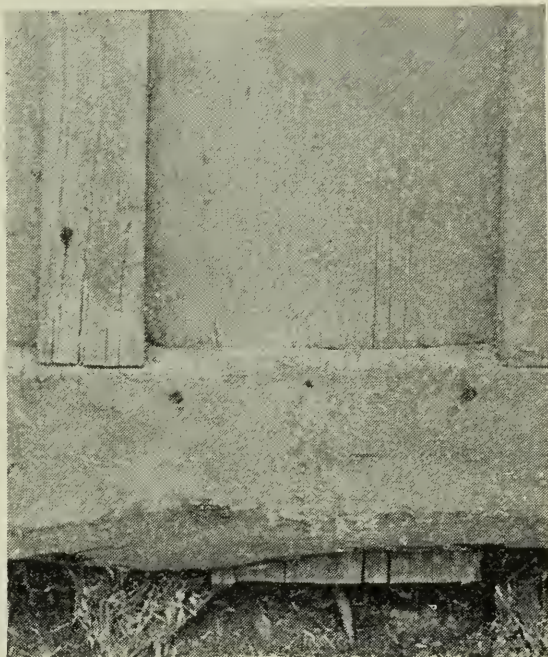
4. *Loss of Gloss*.—Many people are disappointed when after a few months they notice that the paint has lost the gloss. This is a natural result of the aging of the paint. If it has taken place in spots only then it may have been caused by painting over surfaces that are more porous than the adjoining surfaces. It may be noticed on plaster walls over cracks that have been filled with Plaster Paris or over areas that have been sanded.



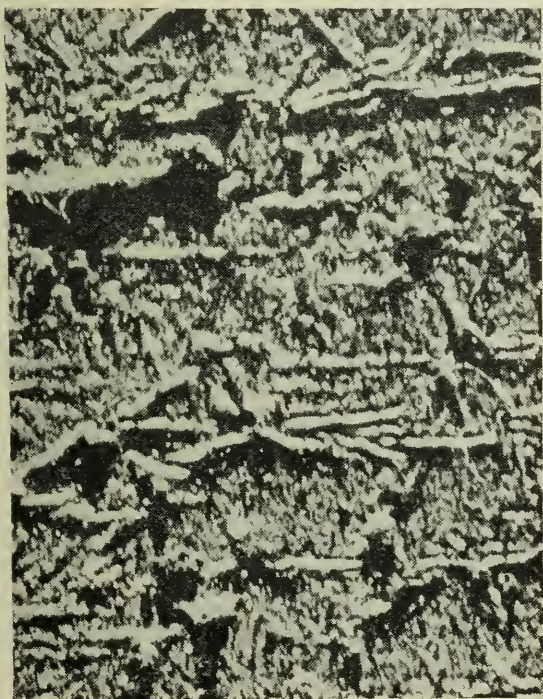
Blistering caused by heat.



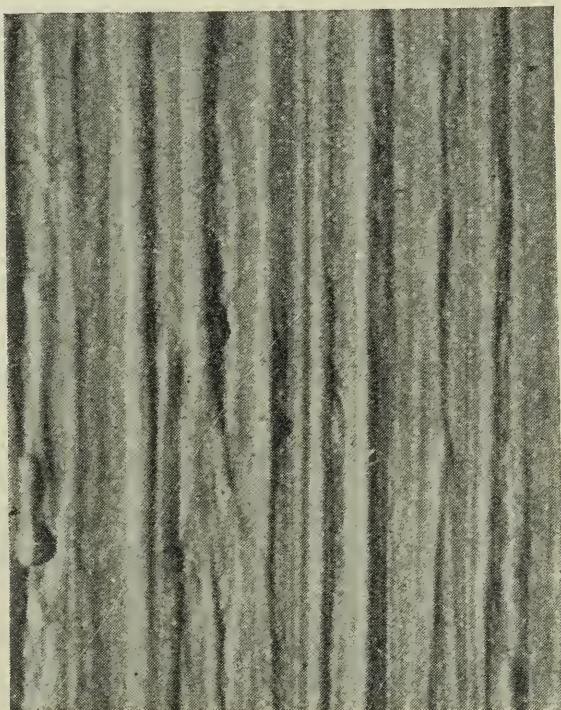
Blistering of paint on moist wood.



Peeling of paint where it is on wood that is in contact with dampness.



Result of painting under dusty and freezing conditions.



Brush Marks. A paint film is no stronger than its thinnest part and best results cannot be obtained unless the paint is brushed out evenly with a good brush.

5. *Yellowing of White Paint Indoors.*—Linseed oil, which is yellow, will not bleach unless exposed to sunlight, so that a minimum amount of oil is generally used for indoor painting and if a gloss is desired it is best gained by using white enamel paints.

6. *Cracking.*—This is a defect extending right down to the wood. It is often accompanied by scaling and is especially noticeable where coat after coat of paint has been added until an excessive thickness has piled up. Another cause may lie in the use of insufficiently seasoned woods. These gradually contract and cause cracks in the paint film.

7. *Checking.*—Unlike cracking this is a surface trouble and may present a fine or a coarse appearance. It lies in the top of the paint film and does not extend to the wood. It is often seen to effect on furniture that has been lacquered over an older varnish or painted surface. It will also happen when paint has been applied over coats that are not sufficiently dry. Inferior materials may be another cause.

8. *Blistering and Peeling.*—Blistering and peeling of paint are caused by moisture or heat and may be found on both wood and metal surfaces. Strong sun shining on paints that are too rich in oil will cause blisters and it is a common thing to see blisters on woodwork that is very close to a hot stove.

Oil or grease left on a surface that is to be painted will cause blistering.

The most common cause of this trouble is to be found in water that is on the surface or in the pores of the wood. If in the wood it may be sap or water that has been absorbed from some outside source. Wood should be well seasoned before it receives other than the priming coat. On the surface it is usually due to rain, melting snow or frost. Painting, when this condition is present, will result in peeling.

Painting the House Outside

1. Estimate area to be painted. Decide on colors.
2. Calculate amount of paint required.
3. Procure or make the paint.
4. Go over the surface, scrape off all loose paint thoroughly, then sand the rough places. Slightly sand all the surface at the same time. Dust off, especially in corners.
5. Replace rotten or broken parts and shellac any knots that have been exposed in the scraping.
6. Go over the windows carefully. All putty should be replaced if loose or missing.
7. Apply coat of priming paint (rather rich in oil) to all scraped portions and new sections.
8. Go over the building, filling all holes with putty. This should be a white lead putty.
9. Apply coat to all surfaces, brushing it well into the wood, working from the peak of the house towards the eaves and from the eaves to base.

Inside Painting

New work, built in cupboards - enamel finish.

1. When the carpenter has finished, go over all surfaces with sandpaper if he has not done so.
2. Shellac all knots and sappy places.
3. Apply priming coat.
4. Putty all nail holes, cracks, etc., with a white lead putty.
5. When quite dry, sand lightly and dust off.
6. Apply 2nd coat. This is a flat coat. Sand lightly when dry.
7. Apply 3rd coat, to which an equal amount of enamel has been added.
8. Sand lightly when dry or rub with pumice powder and water on a felt pad.
9. Dust or clean up thoroughly.
10. Apply enamel as it comes from can.
11. If you wish, rub with finest pumice and water on a felt pad.
12. Clean up thoroughly.
13. Polish with rotten stone and oil.
14. Wipe up with clean dry cloth.

Note:—The last four steps are only carried out when an extra fine finish is required.

The inside of cupboards for pots and pans may be lined with scrap linoleum tacked to bottom and vertical sides. They may also be finished by giving a coat of orange shellac. When this is perfectly dry—over night—they may be varnished with a good tough floor varnish.

Re-varnishing a Worn Floor

When a varnished floor has worn through to the wood in places where it receives hard usage, the worn spots must be attended to first.

1. Wash the floor perfectly clean being careful to rinse it thoroughly.
2. Treat the worn places with a solution of oxalic acid and water—equal parts of each.
3. Rinse thoroughly with clean water.
4. When dry the grain will appear raised slightly and it will have to be sanded to a smooth surface.
5. Sand the old varnish surface to kill the gloss.
6. Wipe up dust with a “tacky” cloth.
7. Varnish the worn spots with a good tough floor varnish.
8. Dry for 48 hours at least, longer is possible.
9. Varnish the whole floor with the same varnish.

Note:—Temperature of room should be about 70°. There should be no dust around.

If very badly worn it may be advisable to remove all the old varnish. Use a good varnish remover and scrape down to the wood. Clean up with benzine and remove stains with the oxalic acid. Rinse, sand and varnish as above.

Re-finishing a Chair

Occasionally you may wish to refinish such an article. If the surface is not in bad condition, proceed as follows :—

1. Wash thoroughly with a strong solution of washing soda to remove all grease.
2. Sand all rough spots until smooth with a number 0 sandpaper.
3. Lightly sand the whole article.
4. Dust off with a "tacky" cloth.
5. Refinish with a colored varnish.

If the surface is in bad condition you had better remove the old finish with a paint or varnish remover. This material is painted over the whole article. The old paint becomes soft and may be scraped off with an old dinner or putty knife. Clean out all corners carefully, then wash with benzine, after which the article may be painted or varnished as in new work.

Waxing Floors

Before rewaxing a floor go over it and clean off all dirty spots with a soft cloth dampened with turpentine. It may not be necessary to touch up more than a few spots but it saves your polishing cloth from becoming excessively dirty. The whole floor should be dusted with a dust mop before attempting to apply the wax.

Use a good grade of wax. Place a lump of the floor wax in two or three thicknesses of cheese cloth and as you rub this over the floor a thin even layer of wax is left on the wood. Allow this to stand for about 15 minutes before polishing. If you try to polish much before this time you will remove a lot of the wax and if you leave it on for a long time without polishing you will find the job more difficult.

A clean soft piece of flannel-like cloth may be used for polishing and a brisk rubbing will soon result in a bright surface being produced.

To prevent worn spots appearing in the floor you should anticipate them by applying a protecting coat of wax on the places that receive the hardest use, about once a week.

All inlaid and plain linoleum can be given a coat of good paste wax as soon as laid. Afterwards you may use the liquid waxes for touching up the parts receiving the most wear.

Water should be wiped off a waxed surface at once. If allowed to remain it will spot the finish.

Painting a Galvanized Roof

Galvanized roofs should be inspected twice a year for the first sign of rusting. This is indicated by a yellowish or reddish brown discoloration. It is high time to paint when this appears. Look for nails that are coming out, withdraw them and put in larger ones to get a fresh hold in the wood. Points of these nails are best if

barbed. Use the heavily galvanized type of nail with large head. See that the metal is down tightly at every point. Line up the eave troughs and clean out any dirt that may be in them. Procure a stiff wire brush something like a scrubbing brush, and clean every particle of rust off. The surface must be clean and dry.

The paint used may be made as outlined for metal painting or a reliable brand of ready made paint having red iron oxide as a base may be used. This paint must on no account be thinned with kerosene or gasoline.

The priming coat should always be put on with the greatest care. It is the foundation upon which the structure rests. Work the paint well into the joints. The last coat may be of some light color, so as to keep a more even temperature inside of the building.

Note:—Paint will not remain for more than a short time if it is applied to new galvanized iron unless the surface is treated first. Dissolve four ounces of copper sulphate in a gallon of water and apply to the surface to be painted when this has dried you will find that the surface has become roughened and there is a thin deposit of copper on it. After about an hour lightly brush off the surface and rinse with clean water. When the surface is dry you may proceed with the painting.

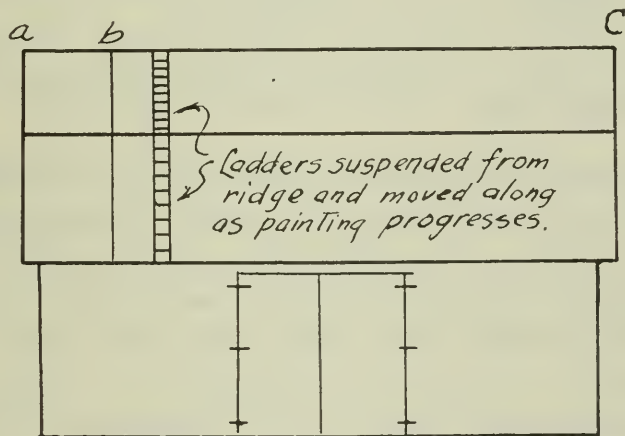


Fig. 8.

This shows ladders suspended from ridge.

Ladders may be suspended from the ridge as shown in Fig. 8. Start work at “a” and paint about ten feet to “b”. Start again at “c” and work back towards “b”. By the time you reach “b” the section “a” to “b” will be dry and the ladders may be placed on it while finishing.

Color Selection

In the selection of colors we must bear in mind the fact that all colors will be affected by the colors immediately surrounding them so that often we find that we have produced an effect that we had no intention of producing. This leads us to consider a few elementary principles in color harmony and contrast, some of which may be stated as follows.

1. A lighter shade appears lighter and a darker shade appears darker if the two are placed side by side.

2. The following pairs of colors when brought together will intensify each other and when a large quantity of one is mixed with a small quantity of the other will produce a gray of the predominating color.

Red and Green.

Blue and Orange.

Yellow and Purple.

3. Colors that are excessively bright, when brought together intensify each other and become inharmonious and unpleasant.

4. A trim color that is darker than the body color has the effect of making a house look smaller. A trim color that is lighter than the body color will make the house look larger. Large houses may well be dark in color and small houses light in color.

One can secure a harmony by using different tones of the same color as varying shades of brown or varying shades of green. If however contrasting colors are desired it will be well to have both colors considerably grayed.

Nature spreads a mantle of green around our homes and by using varying tones of green we can secure harmony. White, browns and greenish grays also harmonize with nature's green. Strong and brighter hues may be used as accents in the trim or the window sash.

Avoid spotty effects, such as one so often sees where there is an attempt at originality without the possession of an artistic sense. Plain elegance is a good rule in all things. Such colors as pink, cherry-red, vermillion and dark blue are not appropriate for outdoor use and in addition are not lasting. In place of them you should use cream, ivory, colonial yellow, light buff, cream gray, etc.

Inside the house we may use more freedom in our selection and adapt the color to the general atmosphere of the room. For example—hall and living room should have soft dull colors as light yellows, greens, blues, browns and grays. Tiffany blends with grey green as the predominant color are very restful. For bedrooms, the more dainty and delicate hues such as mauve, lavender, rose, pale blues, etc., may be used. In den or dining room we can use stronger and richer colors in greens, blues, browns and some dark reds.

We should always take into consideration the exposure or situation of the room. The darker the room, the lighter may be the color used and in rooms receiving plenty of light we may use the darker colors. Northern exposures demand warm colors such as cream, tan, buff, golden brown, etc., while those facing south may have the cool greens, blues and gray browns.

Unless a room is so situated that it is markedly cut off from the rest of the house we should aim to have it harmonize with the general scheme. To do this the color in each room must have something in common with its neighbors.

In the small houses the wall paper should be subdued both in color and design and painted walls should be light tinted.

When we come to consider buildings other than the house we often find that people will throw all rules of good taste to the winds and put on the cheapest red paint that they can buy. Not only are some of these reds unpleasant to look at but they are not durable, neither do they leave a good surface for repainting.

We paint to protect the buildings of course but there is no good reason why we should neglect the principles of good taste. Barns and other buildings should harmonize with the house and with the green of nature. Cream, gray or soft green tones are always pleasing.

A few color suggestions for exterior painting.

<i>Body</i>	<i>Trim</i>	<i>Sash</i>
Pure white	Olive Green	Black or a darker green.
Cream	Light Brown	Sage Green
Leather Brown	Cream	Moss Green
Colonial Yellow	White	White
Chocolate Brown	White	White
Gray (neutral)	White	Dark Green
Cream Gray	Moss Green	Ivory
Ivory	Moss Green	White

WHITEWASHES FOR FARM USE

Whitewash has a wide application to farm use and deserves a much greater popularity than it at present enjoys. Its ingredients are inexpensive and readily obtained; it is not difficult to make and it is easy to apply it. In addition to these advantages, it protects the surface to which it is applied, brightens up dark interiors and is sanitary. A fact not generally known is that whitewash may be colored provided that light tints and shades are used and that the pigments are not affected by lime. Among such are yellow ochre, raw and burnt amber and raw and burnt sienna.

Preparation of the Surface.—The surface to be whitewashed should be just as clean as one that is to be painted and it is a first essential to good results that all dirt, dust, grease and scaly material be removed before there is any attempt to apply the wash. This implies a liberal use of scrapers and stiff brushes. When the cleaning is finished and the surface dusted, it is well to dampen it slightly just before applying the wash.

Application of Whitewash.—Whitewash may be applied with the brush or sprayer. In applying with the brush use one at least four inches wide and work rapidly making no attempt to “brush out” as in painting. Let the coat be fairly thin and transparent and it will be opaque when dry. The small hand sprayers sold by the seed firms may be used. These will cost around \$10 and should be of brass if you expect them to last for a number of years. In using sprayers it is quite necessary that the wash be strained through at least two thicknesses of cheese cloth. Spraying has many advantages over brushing under certain conditions and it forces

the material into cracks and crevices that would not be reached by the brush. In using the sprayer always hold the nozzle so that the wash is applied at right angles to the surface; this gives even application. The sprayer should be thoroughly cleaned after use and especially the nozzles as a small particle of dirt clogging one side of the nozzle will cause it to send out a lop-sided stream and the work will be patchy.

Estimating Quantities.—In estimating the quantity of material required many problems and conditions are encountered, but the following general figures may be used as a basis. One gallon of whitewash will cover approximately 225 square feet of wood, 180 square feet of brick and 270 square feet of plaster. Using a 4-inch brush a man will cover 200 square feet of ceiling, 200 square feet of rough wall or 350 square feet of smooth wall in one hour.

EXAMPLE.—Basement 36' wide x 60' long x 9' high.
Distance around walls is 192 feet.

Area of wall is $192' \times 9' = 1,728$ square feet.
Area of ceiling is $60' \times 36' = 2,160$ square feet.
Total area ----- $= 3,888$ square feet.

225 square feet require 1 gallon
3,888 square feet require 3,888 divided by 225 = 18 gals. approximately.
200 square feet are covered in 1 hour.
3,888 square feet are covered in 20 hours.

Notes on the Preparation of Whitewash

- (a) Prepare the lime and water paste a few days before you wish to use it.
- (b) Where glue is to be used, the solutions must be brought together only when they are *quite cold*. This is very important.
- (c) The glue solution should be added *quite slowly* and at the same time should be stirred vigorously and constantly.
- (d) In no case should you mix more of the wash in one day than you can use in that day when glue is used.
- (e) In place of one sack (fifty pounds) of hydrated lime, you may use the paste made by slaking one-half bushel (thirty-eight pounds) of fresh quick-lime with about six gallons of water. This slaking is sometimes done by placing the quick-lime in a barrel and adding water boiling hot. If cold water is used the water may be added a little at a time stirring each time; when heat ceases to be given off the lime is slaked.

Before using, strain this paste through a fine screen.

(f) Molasses is said to render the lime more soluble and to give it greater penetrating power. Use in proportion of one pint of molasses to five gallons of the wash.

(g) Alum tends to prevent rubbing and is used in proportion of one ounce to one gallon of the wash. It would not be needed in the formulas C and E given below.

(h) If a gloss is desired, dissolve one pound of bar soap in a gallon of boiling water and when it is cold add it to five gallons of the thick wash.

Some Common Formulae

- A. 1. Dissolve fifteen pounds of common salt in seven and one-half gallons of water.
2. *Slowly* add one sack of hydrated lime, *stirring vigorously*.
3. Thin this to a milk like consistency with water.
- B. 1. Make a paste of one sack of hydrated lime and seven gallons of water.
2. Dissolve one pound of common salt and one-half pound of zinc sulphate in one gallon of boiling water. Allow this to cool.
3. Pour this last solution into the lime paste solution a little at a time, stirring vigorously.
4. Stir in two gallons of skim milk.
- C. 1. Dissolve three pounds of glue in two gallons of hot water and allow to *cool*.
2. Make a cream of one sack of hydrated lime and seven gallons of water.
3. Mix (1) and (2), stirring vigorously.
4. Thin to a milk-like consistency.
- D. 1. Make a cream of one sack of hydrated lime and eight gallons of water.
2. Slowly add one quart of crude carbolic acid, stirring vigorously. The quantity of acid may be doubled, if desired.
3. Thin to a milk-like consistency.
- E. 1. Make a cream of one sack of hydrated lime and seven gallons of water.
2. Dissolve six pounds of salt in three gallons of boiling water.
3. Mix (1) and (2) when cold.
4. Stir three pounds of Portland cement into (3).

Uses for the Different Formulae

Formulas A. and B. Unimportant outdoor work, sheds, fences and trees.

“ C. Dry basements.

“ D. As a disinfectant wash but liable to rub.

“ E. Higher grade of work on dairies, buildings and trees.

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DECEMBER, 1939

Ontario Department of Agriculture

Statistics and Publication Branch

TORONTO, ONTARIO

PRODUCING HAY OF HIGHER FEEDING VALUE

BY

O. McConkey, B.S.A., M.S., Ph.D.

DEPARTMENT OF FIELD HUSBANDRY

ONTARIO AGRICULTURAL COLLEGE

GUELPH, ONTARIO



A splendid crop of mixed legume-grass hay in the making.

PRODUCING HAY OF HIGHER FEEDING VALUE

BY

O. McConkey, B.S.A., M.S., Ph.D.

(Acknowledgments—See Footnote)

Importance of the Hay Crop in Ontario

The hay crop of Ontario covers 3,500,000 acres, or about 30 per cent of the crop acreage of the Province. The average annual value of the hay crop over a ten-year period exceeds \$70,000,000. The oat crop of the Province ranks next in value over the same period at \$47,000,000.

Climate and Soils Adapted to Hay Production

The comparatively cool temperatures of the region and the usually well distributed rainfall during the growing season are favourable to the growth of hay plants. During the harvest season the general high temperatures and rapid evaporation facilitate curing, but intermittent storms often cause heavy losses in the feeding value of the hay crop.

The high lime content and good drainage of the major soil types favour the growth of legumes, especially alfalfa and red clover. Ontario is sometimes called the "Land of Legumes."

Phosphorus, potash and nitrogen are found to be limiting factors in hay production on many farms and soil types.

Hay is One of Our Lowest-cost Feeds

The importance of producing hay of **higher feeding value** to **lower the cost of live stock and dairy production in Ontario** needs to be emphasized in the agriculture of the Province, because hay furnishes the **cheapest home-grown feed** for the long stable-feeding period of seven months in this northerly region.

Recent cost studies show that, apart from **pasture**, **hay** is the **cheapest feed** produced on Ontario farms. The comparative cost of producing a **ton of digestible nutrients** from different crops is as follows: Pasture mixture \$5.66; Alfalfa hay \$11.85; Red Clover hay \$13.50; Corn silage \$19.16; Mangels \$35.19; Oats (grain) \$36.81. None of these crops should be neglected,

ACKNOWLEDGMENTS:

Analyses of samples of hay were made by the Department of Chemistry.

Information on cost studies, feeding methods, value of feeds, and other related material, was considered with the Departments of Animal Husbandry, Economics, and Field Husbandry.

but the above figures indicate that, in Ontario crop production, more attention should be paid to producing hay of **higher feeding value** in order to lower the cost of producing our live stock and dairy products.

Survey of the Quality of Ontario Hay

The analyses of 105 samples of hay collected from farms in different counties show what wide variations are found in the **protein, calcium, and phosphorus** content, and hence the **feeding value** of hay grown on different farms.

The **protein** content ranged from a low of 5.01% to a high of 21.75%. The low-protein sample was **late-cut timothy**, and the high sample contained a **well balanced mixture of 66% alfalfa and 34% timothy, cut early**.

The **calcium** content ranged from .22% to 2.99%. The low sample contained 90% timothy and 10% clovers, **cut late**, and the high calcium sample contained 100% alfalfa, cut early.

The **phosphorus** content ranged from a low of .06% to over .22%. The low sample was late-cut timothy from acid soil, and the high phosphorus sample contained 85% alfalfa, 10% red clover, 5% timothy, and was grown on clay-loam soil.

The above survey shows the importance of (1) using well balanced legume-grass mixtures; (2) cutting hay early for high protein content; (3) the importance of seeding on fertile soil, well mineralized with calcium, phosphorus and potash in order to produce high-quality hay.

Principal Hay-producing Plants

It is interesting to observe that we are not growing any important grasses or legumes for hay production which are **native** to Ontario. The early settlers found that the native grasses, which were adapted to growing under the shade conditions of the natural forest cover, or in wet habitats, were in the main useless for hay and pasture production in the open cleared fields. The pioneers imported mixed seed gathered from the age-old pastures and meadows of Great Britain and Northwestern Europe.

There followed a severe climatic selection under the New World conditions and a survival of the fittest of those plants adapted to our climate and soil. Those plants which could survive under our cold winters and dry summers established themselves as the important hay plants, i.e., Timothy, Red Clover, Alsike, Alfalfa, Sweet Clover, together with a more limited distribution of Orchard grass⁴ and Meadow Fescue; while Kentucky Blue, Canadian Blue, Red Top, Brown Top and White Clover colonized the pasture lands of Northeast America.

Adaptation and Agricultural Value of Our Principal Hay Plants

Alfalfa. Alfalfa should be seeded on well drained soils, high in lime, phosphate and potash. It winter kills on poorly drained soils. Alfalfa is our highest yielding hay plant. In nutritive value it is high in protein and mineral content. It is deep-rooted and drought-resistant, and for this reason furnishes good aftermath pasture during the dry period. This valuable high producing plant should be included in mixtures with grasses wherever it is adapted.

The acreage of alfalfa of approximately 650,000 acres in the Province should be increased.

Red Clover. Red clover has a wide adaptation over different soil types in Ontario. It thrives best on well drained soils high in minerals, and usually responds to phosphate fertilization. In combination with timothy it makes high-quality hay which is favoured by stockmen, especially if it is cut early. Improved perennial strains are being developed at the College.

Alsike. Unlike red clover, alsike will thrive in poorly drained acid soils, but prefers a fertile clay-loam. It is also more winter hardy, and for these reasons it is good insurance to use one or two pounds of alsike seed in mixtures on fields with low areas.

Timothy. Timothy is the most widely grown grass for hay production in Ontario. It prefers a friable, moisture-holding clay-loam, high in minerals and nitrates. It does not thrive on light, dry soils. It is very winter hardy, and is palatable and nutritious **when cut early**. The seed is cheap and easy to sow. This popular and valuable hay grass should be included in mixtures



Multiplication blocks of improved strains of grasses.

with alfalfa and red clover, because it provides insurance against winter killing in seasons of severe injury to legumes, and besides it balances the feeding value of the mixture.

Improved, more productive, leafy, rust-resistant strains have been developed at the O.A.C.



Improved strains of clovers and grasses.

Orchard Grass. Orchard grass is adapted to the lighter gravelly soils, but prefers a fertile clay-loam. It is a very productive, leafy bunch-grass. This grass catches better than timothy in a dry season, and is one of our most drought-resistant grasses during the dry July-August period, providing aftermath pasture along with alfalfa at this critical period.

Orchard grass matures quickly, and precaution should be taken to cut early in the bloom stage for best results.

It is shade tolerant, vigorous growing and fills the bottom, and for these reasons it is useful in combined hay-pasture mixtures to provide more aftermath pasture and better balanced feed. Add 4 to 5 lbs. of orchard grass to the mixture used.

Awnless Brome. Brome grass was originally introduced from the plains of Hungary to Western Canada. It is very drought-resistant, winter hardy

and palatable; it makes a good bottom grass with alfalfa, and is proving useful in combination hay-pasture mixtures to give a thicker bottom and more aftermath pasture. It is adapted to light or gravelly soils. Add 7 to 8 lbs. to the mixture used.

Methods of Producing Better-quality Hay

Soil Fertility. Soil of high fertility is the first essential to secure a good catch of small seeds and to produce hay of high feeding quality. Experiments have shown that **an application of phosphorus at the time of seeding** increases the establishment of young seedlings and helps to prevent winter killing of legumes.

It is a wise precaution to have a soil test made before seeding and apply a balanced fertilizer.

Weed-free Soil. Seed down after a cleaning crop or summer fallow if necessary. Too many seedings are made on weed-infested soil.

Methods of Seeding

The most favourable conditions for the successful establishment of young seedlings of grasses and clovers are (1) fertile soil; (2) adequate moisture; (3) fairly cool temperature, e.g., early spring and fall weather; (4) minimum competition and shading from the nurse crop.

The soil should be worked to a **fine condition** because the seeds are small, and the seed bed should be **firm**, which helps to bring up an even supply of moisture from the subsoil to the young seedlings. Experiments have shown that the **cultipacker** is one of the best implements to use right after seeding. Its action is to cover and press the loose soil around the small seeds, and the firm soil maintains a more even supply of moisture for the young seedlings than does a loose, open mulch.

Broadcast seeding, either with the grass seed attachment on the grain drill, or the Cyclone seeder, usually gives the best results under Ontario conditions. On dry soils and in dry seasons it has sometimes been found more successful to mix the small seeds with the grain, and seed through the grain spouts so that the seed is in contact with the moisture. This is especially true of such seeds as orchard, brome, and alfalfa. Care should be taken not to seed timothy, red clover or alsike, or any small grass seed, too deeply.

Time of Seeding

The most favourable season for seeding is the **early spring**, when moisture and temperature conditions are favourable.

Timothy may be seeded with fall wheat in the southern counties of Ontario with safety, because it is very winter hardy. Experiments at Guelph have shown that the **clovers and alfalfa** should not be sown after July 1st because of the danger of winter killing.

Nurse Crops

1. Use a light seeding of early oats or barley at one bushel per acre. Heavy nurse crops kill young seedlings.

2. Good catches are obtained by **carefully** pasturing off the nurse crop. This eliminates the shade and competition from a nurse crop which is allowed to mature. Start grazing when oats are twelve inches in height, and be careful not to overgraze.

3. Broadcast seeding on winter wheat in the early spring on snow and when the soil is moist is often a successful method, because wheat is harvested early and so gives the young seedlings a long season of growth in the fall. A heavy crop of wheat is unfavourable because it shades out the seedlings

Care of the New Seeding and the Hay Meadow

In this northern region care must be taken to give grasses and especially the clovers and alfalfa every opportunity to make a **good growth in the fall** in order to store up **food reserves** in the **roots** to prevent winter killing, and the following precautions should be observed:

1. Do not **overgraze or cut a new seeding or hay meadow too closely in the fall**. Such treatment lowers the vitality of the plants and is followed by heaving and winter killing.

2. A soil in high fertility, especially the minerals, prevents winter killing.

3. Many farmers are finding it profitable to top dress their hay meadows with well rotted barnyard manure which has been reinforced with phosphate in the stable. This is best applied in the early fall to strengthen the plants going into the winter.

Mixtures for Hay and Combination Hay-Pasture

Choose a mixture **adapted** to your particular soil type and feeding requirements. It should be a well balanced legume-grass mixture. The characteristic open bottom of Ontario meadows can be improved by using more timothy and the shade-tolerant grasses, orchard and brome, which make a thicker bottom, especially with alfalfa.

MIXTURES FOR HAY AND COMBINATION HAY-PASTURE
RATES OF SEEDING IN LBS. PER ACRE

Well Drained Alkaline Clay-loam

Mixture No. 1	Mixture No. 2	Mixture No. 3	Mixture No. 4
Alfalfa.....12	Red Clover..... 6	Alfalfa..... 6	Alfalfa..... 6
Timothy..... 6	Alsike..... 2	Red Clover..... 4	Red Clover..... 4
	Timothy..... 6	Alsike..... 2	Alsike..... 2
		Timothy..... 6	Timothy..... 6
			Orchard..... 4
			or
			Brome..... 7

Light or Gravelly Soil

Mixture No. 5
Alfalfa..... 6-8
Red Clover... 4
Timothy..... 4
Orchard..... 4
Brome..... 4

Poorly Drained Acid Soils

Mixture No. 6
Alsike..... 2-3
Red Clover... 4
Timothy..... 6-8
Meadow
Fescue..... 4

Mixtures Nos. 1, 2 and 3 are designed for hay and to meet different feeding requirements. Mixture No. 4 will give a higher yield, closer bottom and more pasture because of adding orchard or brome.

Cut Hay Early

Fodder plants become woody and the cells encased in lignin as they approach maturity, and there is a gradual drop in **digestibility**. For example, digestion experiments have shown that grass in the pasture stage is digested **83%**, while the same grass left to the **hay stage is only digested 52%**. Further, it has been shown that the food nutrients become "locked" in the more mature, lignified cells in late-cut hay so that the digestive juices cannot attack them. Experiments show that in hay cut June 20th, **65% of the protein was digested**, while in the same hay left until July 20th, **only 47% of the protein was digested**.

TABLE SHOWING YIELD AND PROTEIN FROM TIMOTHY
CUT AT DIFFERENT STAGES

Stage	Yield per Acre in Lbs. Dry Matter	% Protein	Protein per Acre in Lbs.	AFTERMATH		Total Protein per Acre in Lbs.
				Yield per Acre in Lbs.	Protein per Acre in Lbs.	
Heads Formed.....	1,596	12.8	205	922	99	304
Bloom.....	1,683	10.9	184	676	83	267
Past Bloom.....	1,765	8.6	150	351	49	199
Seed Formed.....	1,863	6.8	126	239	35	161

This table shows the value of cutting timothy early to produce hay of high feeding value. Note the **higher percentage of protein and total protein per acre in the early stages of cutting**, and furthermore that there is more **aftermath** from the earlier-cut hay. This is true of other grasses, clovers, and alfalfa as well.

Note also what early cutting of hay means in terms of **crop acres, oilcake, and bushels of oats**:—

From the foregoing data on digestibility and yields it is found that an acre of hay cut in the **early bloom stage** yields **173 lbs. of digestible protein**, while an acre cut in the **late seed-forming stage** yields only **75 lbs.** of digestible protein. This is a gain of 98 lbs. of digestible protein per acre by cutting hay early. In other words, it requires **2.3 acres of late-cut hay** to equal **one acre of early-cut hay**, in terms of digestible protein.

Considering that oilcake contains 33.5% digestible protein, the saving of 98 lbs. of digestible protein per acre by cutting hay early is equivalent to the saving of the digestible protein contained in 293 lbs. of oilcake, worth approximately \$5.86.

A bushel of oats contains about 3.5 lbs. of digestible protein. It would, therefore, take 28 bushels of oats to contain 98 lbs. of digestible protein—the amount saved per acre by cutting hay early.

The feeding value of Ontario hay can be greatly improved by cutting at earlier stages of growth. Early-cut hay furnishes our **cheapest source of protein for winter feeding** and cuts down on the outlay for “bought in” concentrates.

Early-cut hay is more palatable and digestible, and when fed to cows it produces more milk than late-cut hay. Furthermore, there is more production of aftermath following early-cut hay, and this conserves moisture and furnishes pasture. Thus by this management the largest amount of actual feed is obtained from the hay crop. **Early cutting of hay controls weeds.**

STAGE OF CUTTING FOR BEST-QUALITY FEED

Timothy.....	Early bloom stage
Alfalfa.....	Tenth bloom stage
Red Clover.....	Half to full bloom stage

Curing and Preservation of Food Nutrients

High-quality hay should be green, palatable, easily digested, and high

in percentage of leaf, minerals and vitamins. The more green colouring matter which can be retained when curing hay the higher will be the content of the different vitamins, especially A, which is valuable in winter feeding. **Over-exposure** to sun bleaches out the green chlorophyll and lowers the vitamin A content. Reasonable exposure to sunshine when curing increases the vitamin D. Exposure to rain causes heavy losses in the feeding value of hay, as shown in the following table, and should be guarded against as much as possible.

LOSSES IN HAY MAKING

Weather	Dry Matter	Starch Equivalent	Protein Equivalent
	%	%	%
Showery.....	37	43	54
Fine.....	17	33	29
Very Fine.....	10	23	17

Methods of Curing

In all hay-making operations every effort should be made to **retain the leaves**, because the leaves contain more feeding value than the stems, especially **minerals** and **protein**.

Rainy weather is the greatest hazard to successful hay making, and since weather is beyond man's control all that can be done is to take precautions and modify methods where possible to preserve feeding value. e.g. (1) Do not cut too large an acreage ahead of the curing operation; losses are much greater in the swath than in standing crop, when it is raining. (2) If labour is available it pays to cock hay, especially alfalfa and the clovers. Some farmers are using oiled factory cotton coil covers successfully. (3) **When hay is stacked, tarpaulin stack covers** should be used to prevent the enormous losses which now occur in unprotected haystacks in Ontario. (4) If the side-delivery rake is drawn in the opposite direction to the mower it tends to throw the leafy parts inward, exposing the stems, which is an advantage.

Tripod Curing

Tripods made of seven-foot poles (see illustration) can be used to advantage to cure early-cut hay from a portion of the hay acreage. This

will give high-quality hay, and the area will furnish **early aftermath pasture**. Early cutting, with the use of tripods, distributes the period of hay making so that more of the crop can be cut at the proper stage.



Tripod for curing early-cut hay.

Molasses Silage

Another method of preserving early-cut hay and of saving hay in catchy weather is to ensile it, using molasses, which helps to preserve the feeding value.

To make molasses silage, cut a legume-grass mixture **early**, before bloom and not later than one-tenth bloom, draw it in directly it is wilted and cut it as fine as possible, adding 60 lbs. of molasses per ton of green fodder as it is being fed into the cutting box. Tramp firmly in the silo to exclude air and prevent spoilage. The ensiled crop should have a moisture content of approximately 70 per cent.

The **advantages** of making some molasses silage from early-cut hay are:

1. Well preserved legumes-grass silage makes good feed. It is usually higher in vitamins, protein and mineral content than corn.
2. It can be fed to the herd during the dry, hot July-August period to advantage when pastures are short, or carried over for winter feed.
3. There is usually a good aftermath following the early cutting, especially if alfalfa and the drought-resistant grasses, orchard and brome, are used

in the mixture. This can be utilized for pasture to advantage during the late summer season. The grazing should be controlled by the use of electric fences.

4. Distributes the labour of haying.



Mixing molasses with alfalfa as it goes through the cutting box and thence into the silo.

Annual Hay Mixtures

In an emergency, when additional hay supplies are needed, the following crops and mixtures are recommended for sowing in the spring:

NO. 1
Oats..... 2 bus. per acre
Peas..... 1 bus. per acre

NO. 3
Millet.....30 lbs. per acre

NO. 2
Oats..... 2 bus. per acre
Sudan Grass...20 lbs. per acre

NO. 4
Soybeans..... 2 bus. per acre

These crops should all be cut in early stages of growth in order to make the best quality hay, e.g., oats in the milk stage, soybeans when the pods are about half developed, millet and sudan grass in the early-bloom stage.

Avoid Barn Fires

There are heavy losses annually in Ontario from barn fires caused by spontaneous combustion. These fires are often caused by putting hay in mows when it is still tough or damp. The moisture content must be low before hay will store safely. Test it before drawing in. Take care to spread any hay in the mow that feels slightly tough; a solid mass of tough hay in a mow surrounded by dry hay acts like an exploding match box.

NOTE:—For information on commercial market grades of hay, write to The Plant Products Division, Dept. of Agriculture, Ottawa, for Official Hay Standards.

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STATISTICS AND PUBLICATIONS BRANCH
TORONTO, ONTARIO

SOYBEANS IN ONTARIO

BY

Dr. G. P. McRostie
and
J. Laughland

DEPARTMENT OF FIELD HUSBANDRY
ONTARIO AGRICULTURAL COLLEGE
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A typical growth of soybeans.

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SOYBEANS IN ONTARIO

By

Dr. G. P. McRostie and J. Laughland

The soybean (*Glycine hespida*) is a legume. It is a native of Eastern Asia and still may be found growing wild there. It is one of the world's oldest crops. Chinese writings dating as far back as 2838 B.C. mention its great economic importance.

The soybean was introduced into the U.S.A. in 1804. In the latter part of the same century it attracted the attention of experimental stations, and since then its development and popularity has increased very rapidly.

The soybean was first grown at the Ontario Agricultural College in 1893 and distribution among farmers began in 1901. In 1929 the Field Husbandry Department of the Ontario Agricultural College organized co-operative soybean demonstration plots in many sections of the province. Now many farmers have included it in their cropping systems and a great many others are studying it with interest.

THE PLANT

The soybean is an erect growing, branching, bushy annual legume, having hairy stems and sometimes hairy leaves. Its height varies from one to six feet, according to soil, climate and variety, but the varieties suitable for Ontario average from two to three feet in height.

The leaves are trifoliate and vary in shape, size and colour. They usually turn yellow and drop off by the time the plant reaches maturity. However, some varieties retain their leaves after the pods have fully ripened. The portion of the soybean plant below the ground level consists of a strong taproot with many branches. A large number of nodules adhere to these when the soil is well supplied with the necessary type of nitrogen fixing bacteria. The flower is small, white or purple, and almost entirely self fertilizing. There are usually two to four seeds contained in a short, hairy pod. The common seed colours are yellow, olive yellow, olive green, brown and black.

USES

The soybean is used in more ways than any other cultivated crop. More than four hundred commercial products can be made from it and new ways of using it are annually being discovered. The following are some of its chief agricultural uses.

Hay. Soybeans, when properly harvested, make an excellent annual hay which has approximately the same feeding value as alfalfa. Because they can be sown in May and cut in August, soybeans offer an excellent substitute when there is a shortage of staple hay crops. Yields of hay in Ontario average over two tons per acre.

Seed. The chief value of the soybean seed lies in its ability to supply protein to a ration. It provides an excellent concentrate feed for many classes of livestock. Rations containing soybean seeds, when fed to dairy and beef cattle have given satisfactory returns.



Ripe Soybean plants grown at the Ontario Agricultural College. Note the abundance of pods and their even distribution on the plants.

Straw. Because most of the leaves fall from the plant at maturity, soybean straw is of poorer quality than many other straws. Its best use is for feeding in combination with other roughages to sheep, horses and young cattle.

Soybean Meal. The cake which remains after the oil has been extracted from the bean is ground and fed to livestock. It contains about forty per cent protein and may be fed in the same proportions as other kinds of oilmeal.

Soiling Crop. Soybeans are valuable as a soiling crop to be cut and fed green in midsummer when pastures are short. Yields of over eight tons of green fodder are common.

Ensilage. Soybeans alone should not be stored in the silo because they produce a bitter silage with a disagreeable odour. One part soybeans to three of corn is a good mixture. Under Canadian conditions these two crops are best grown separately and mixed as they are put in the silo because, when grown together, harvesting is difficult. A seven year experiment at the Ontario Agricultural College in which a mixture of dent corn and soybeans is compared with dent corn alone showed that no appreciable extra tonnage may be gained by sowing soybean and corn mixtures.

Soil Improvement. The soybean, like other legumes, by means of bacteria on the roots, is able to gather nitrogen from the air and store it in the roots. When soybean stubble is turned under this nitrogen is made available for the crops that follow, but the soil derives the greatest benefit from the soybean when the whole plant is plowed down in the only podding stage. The best results, however, can only be obtained when the soybean seed is well inoculated with the required nitrogen gathering bacteria.

Soybean Oil. The soybean seed is rich in oil (approximately 18%). This oil is extracted by the hydraulic press, the expeller or the solvent system. The crude oil is used in the manufacture of soap, paint, rubber substitutes, printer's ink, explosives and many other articles, while the refined oil is a component part of many edible products.

Other Products. Soybean flour, which is made into bread, cakes and muffins, due to its very low percentage of starch, is of especial value as a diabetic food. Soybean milk, curd and breakfast foods are products of this bean. Lecithin, a complex fatty material containing phosphorus and nitrogen is also obtained from the soybean and is used in candy making. Green soybeans, dried beans and bean sprouts are used in many ways for the table.

FEEDING VALUE

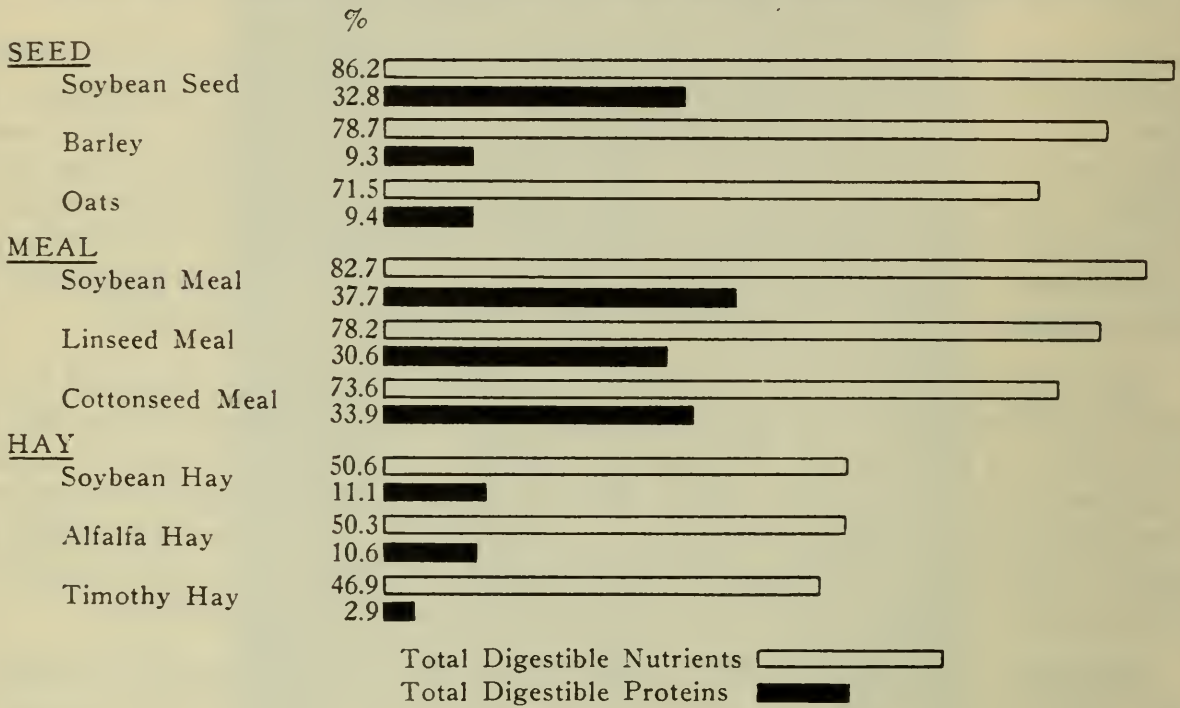
The seed of the soybean has a high percentage of digestible nutrients, particularly digestible protein. Its nutritive value is much higher than that of oats or barley, and it is higher in proteins than flaxseed. Soybean hay has approximately the same nutritive value as alfalfa hay, and soybean meal is superior in that respect to both cottonseed and linseed meal.

Soybean seeds are higher in minerals such as calcium and phosphorus than either oats or barley. Soybean hay, likewise, is richer than alfalfa and timothy in calcium and phosphorus, but lower than cottonseed and linseed meals in these minerals.

Soybean seeds contain a fair amount of vitamin B¹ and some B² (G). They have approximately the same vitamin content as wheat, oats and barley, but are inferior to corn in this regard.

The following graph compares the digestible nutrients and protein of soybeans with other common feeds.

FEEDING VALUE OF SOYBEANS COMPARED WITH OTHER FEEDS



The following table shows the high yield of protein from an acre of soybeans in comparison with barley and oats. Percentages of digestible proteins are also listed.

Table 1
Comparison of Yields of Protein
From an Acre Each of Soybeans, Barley and Oats

Crop	Average Yield per acre	Protein Lbs. per Acre	% Protein which is digestible
Soybeans	20.7 bus.	458.29	90.0
Barley	32.1 "	181.81	77.0
Oats	36.7 "	149.73	78.2

These results indicate that the soybean is an ideal home grown concentrate which may replace or supplement other concentrate feeds in rations.

CLIMATIC ADAPTATION

Soybeans require about the same range in temperature and length of growing season as corn. They are more resistant to drought or to excess of moisture than the corn crop. Late spring frosts that will kill field peas do not injure the soybean, and the crop, if not already ripe, will continue to mature after light early autumn frosts. When suitable varieties are used, soybeans can be grown for fodder and grain over the greater part of old Ontario.

PLACE IN ROTATION

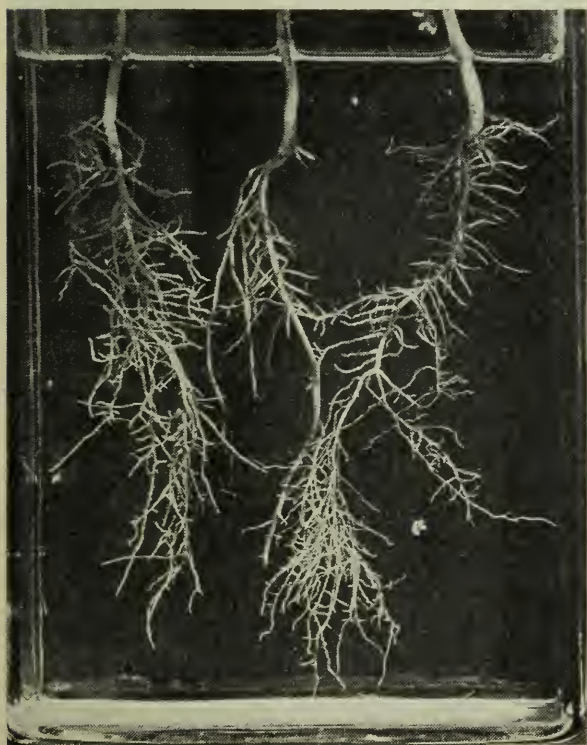
Soybeans are well suited to short rotations. They can be advantageously included in that part of the rotation usually devoted to roots and corn. In this way they help to fill out that section of the rotation which is sometimes not all required for hoed crops. Where winter wheat has failed or where new meadows must be broken up, soybeans, as a cash crop, have given gratifying results. They can also be grown with advantage as a substitute for a small portion of the oat acreage.

CULTURE

Soil. Soybeans have been grown successfully on many types of soils, but they give best results on mellow, fertile loam or clay. In general, soybeans require about the same soil as corn, but they will thrive better in acid soil than clovers.

Preparation of Seed Bed. Fall plowing is best for soybeans. Late spring plowing does not allow sufficient time for decay of growth which has been turned under. Such land has a tendency to become dry. Like corn, soybeans respond readily to extra soil preparation. A well worked seed bed is conducive to earlier germination, a good stand of plants and permits earlier cultivation.

Manure and Fertilizers. High yields cannot be expected on soils that are low in fertility without the use of stable manure or commercial fertilizer. Good crops of soybeans can be grown on sod, plowed and manured in the fall, or following a cultivated crop such as roots or corn to which manure has been applied. Where a clover has been plowed down, 0-12-6 fertilizer is satisfactory but on soils low in nitrogen, 2-12-6 should be used. An application of 250 lbs. per acre is recommended.



5 weeks old—Not inoculated.



5 weeks old—Inoculated.

A comparison of root development in soybeans 5 weeks old, uninoculated and inoculated. Note abundance of nodules on inoculated plants.

Seed Selection. The highest yields cannot be obtained without the use of good seed. It should be well matured, large for the variety, uniform and free from split beans. Soybean seed loses its vitality with age, the yellow seeded varieties usually assuming a pale appearance. If there is any doubt regarding the freshness of the seed, a germination test should be made.

Inoculation. Like other legumes, soybeans are able to gather nitrogen from the air and store it in the roots in pea-like nodules through the agency of certain bacteria which live on the roots. The presence of these bacteria enables the soybean to produce the greatest percentage of protein in the plant and the highest yields of green fodder and grain. When the crop is being sown for the first time on a field, the seed should be inoculated with the required kind of bacteria culture. This culture may be obtained



Not inoculated.



Inoculated.

A comparison of soybean shoots at 5 weeks of age.

from the Bacteriological Department, Ontario Agricultural College, Guelph; Division of Bacteriology, Central Experimental Farm, Ottawa, or from commercial firms handling this product. These cultures should be applied to the seed according to directions which are sent with them.

Other methods of inoculation have been used with varying degrees of success. One such is to sprinkle the seed with a solution obtained by stirring equal measures of water and soil, then straining off the resultant liquid. About a pint of liquid per bushel of seed is required and drying in the shade is necessary after treatment.

Dates of Seeding. Soybeans may be sown any time after danger of severe frost is over. May 15th has been found to be a satisfactory seeding date, but if the soil is cool, it is advisable to wait longer. Nothing is gained by seeding before the soil has become well warmed up.

Methods and Rates of Seeding. Soybeans usually are sown with a grain drill. There are two methods of sowing, depending on the use of the crop. For grain, the seed is sown from every fourth spout of the drill in rows about twenty-eight inches apart. This will require approximately forty-five pounds of seed per acre. For hay, soybeans should be drilled solid like oats or barley at the rate of about one and three-quarter bushels per acre. In general, the rate of seeding should be heavy enough to allow for a few plants being pulled out by the harrow and still leave a stand of plants spaced about three inches apart in rows. If the land is weedy, however, drilling seed solid will not give satisfactory results because weeds tend to grow faster than soybeans and, since cultivation is difficult, will sometimes overcome the crop.

Depth of Seeding. A satisfactory depth of seeding is from one to two inches on heavy soil and should not exceed three inches on lighter soil.

Seasonal Care. Soybeans should not be sown on land badly infested with twitch grass, sow thistle or similar perennial weeds. The annual weeds may be fairly well controlled previous to planting by spring cultivations. Weed control may be continued during the growing season with a harrow or weeder.

Cultivation should be frequent enough to control weeds. It should not start before the plants are two or three inches high and should cease when they reach the six-leaf stage, but if a crust forms it is advisable to break it by harrowing two or three days before the plants break through. Harrowing, to the new grower, may seem drastic, but is necessary to control weeds. Later cultivation between the rows should be about the same as for corn.

Harvesting—*For Hay.* To produce hay of the greatest palatability, digestibility and highest yield, soybeans should be cut when the pods are well developed and the beans have attained about one half their normal



Soybeans ready for harvesting.

size. Cutting should commence as soon as the dew is off the crop. After cutting, hay should be allowed to remain in the swath for a day, then raked into windrows or made into coils and allowed to stand until well cured.

For Seed. The soybean crop is ready for cutting when the pods are ripe, which, with most varieties, is when about 95% of the leaves have fallen. It may be cut with the grain binder, shocked and handled similar to other grain crops.

Occasionally the Self Rake Reaper or Pea Harvester is used for cutting. With the short early varieties a mower has been used successfully. This machine must be adjusted to cut very close to the ground, and to avoid shelling the cut material by tramping, it is necessary to move it to one side sufficiently to permit the free passage of the horses and mower.

In some districts soybeans are occasionally harvested by combines, but due to shelling, considerable losses are often reported.

Threshing. Soybeans should be dry before hauled in or threshed. The crop is frequently threshed directly from the field, but many growers believe that storing in the mow for a time before threshing results in better quality seed.

A special bean thresher may be used to thresh soybeans, or the ordinary grain thresher may be modified for this purpose. The cylinder speed of the grain thresher should be reduced to almost one half its regular rate. However, the other operating parts of the thresher should function at their normal speed. In addition, the number of teeth in the concave should be reduced to a single row or the entire concave replaced by a wooden blank. Care should be exercised in threshing to avoid splitting of beans.

Storing. Beans should be dry before they are stored. If the storage bins are deep they should be ventilated.

VARIETIES

The importance of the soybean is shown by the fact that more than two hundred varieties have been developed. Over one hundred and twenty-five varieties of soybeans have been tested for fodder and grain production by the Field Husbandry Department of the Ontario Agricultural College. A number of these varieties matured sufficiently early to be successfully grown in Ontario. Many, however, were too late for the climatic conditions of the province and did not reach the best stage for forage production before the arrival of killing frosts. It is, therefore, of the greatest economic importance that the variety selected should be adapted to local conditions and to the purpose for which the crop is sown.

The following table is the result of nine years' tests at the College with twenty-eight of the varieties more suitable for Ontario. The varieties have been arranged into maturity groups and the highest yielders of grain have been placed at the top of each group. The Kabott variety has been tested only two years so that the averages are not yet significant, but it is early maturing and appears to be satisfactory from the standpoint of yield. Yields of hay and the average height of the plants are also given.

Table 2
Seasonal Records of Soybean Varieties

Varieties	Average of 9 Years' Tests				
	Type	Average Date of Ripening	Average Height of Plant (In.)	Average Yield	
				Cured Hay per acre (tons)	Grain per acre (bushels)
Goldsoy.....	Very Early	Sep. 12	22	2.29	30.82
Mandarin (M.A.C.).....		Sep. 13	24	2.79	30.51(5)*
Brown.....		Sep. 12	22	1.96	23.23
Ogemaw.....		Sep. 1	26	1.94	19.65
Manitoba Brown (M.A.C.).....		Sep. 4	15	1.93	18.70(5)*
Kabott.....		.....	..	....	.....
Mandarin.....	Early	Sep. 18	26	2.50	30.67
Black Manchurian (Jeffrey).....		Sep. 18	27	2.28	27.77
Mandarin (Ottawa).....		Sep. 17	25	2.09	27.13(3)*
Early Yellow.....		Sep. 18	24	2.20	27.12
Cayuga.....		Sep. 16	32	2.59	26.35(3)*
Tsurunoko.....		Sep. 17	24	2.05	26.35
Minsoy.....		Sep. 19	22	2.23	26.00
Hudson Heights.....	Mid-seasonal	Sep. 24	28	2.74	32.27(6)*
O.A.C. #211 (Plant #1).....		Sep. 28	26	3.31	31.25
Minnesota #167.....		Sep. 28	31	2.81	30.95
O.A.C. #211.....		Sep. 29	27	2.71	30.42
Manchurian (Black eye).....		Sep. 29	28	2.77	29.22(6)*
Illini.....		Sep. 30	17	2.62	29.22
Manchurian (Yellow eye).....		Sep. 29	26	2.56	28.25(6)*
Quebec #92.....		Sep. 24	21	2.16	26.27
Manchu (O.A.C.).....	Late	Oct. 1	32	2.69	29.37
A.K. 2 (O.A.C.).....		Oct. 1	28	2.67	29.28
Habaro #20405 (Wash.).....		Oct. 1	26	2.59	28.60
Manchu (Harrow).....		Oct. 3	35	2.85	28.23(6)*
Ito San Soja.....		Oct. 2	29	2.78	26.37
A.K. (Harrow).....		Oct. 4	36	2.99	24.65(6)*
Illini (Harrow).....		Oct. 4	35	2.98	24.47(6)*

*Numbers in brackets indicate the duration of the test when less than nine years.

DESCRIPTION OF VARIETIES

Manitoba Brown (Brown, Ogemaw). Both Manitoba Brown and Brown are varieties which have been selected from Ogemaw which was introduced by E. E. Evans, West Branch, Mich., 1902, as a supposed cross between Early Black and Dwarf Brown varieties. The Manitoba Brown is an early selection made at the University of Manitoba. All three are similar in appearance and may be described as follows: seed colour brown, medium to large in size, hilum chocolate; plant short, erect, bushy; flower purple. They are very early varieties suitable for seed and may be successfully grown in northern districts.

Kabott. A selection from a Manchurian strain secured by the Central Experimental Farm, Ottawa, through Mr. R. R. Kabalkin. Recent tests of this variety at the Ontario Agricultural College show promising results. Seed yellow, medium large, hilum yellow; plant medium short, branchy; flower purple; suitable for seed and fodder in the shorter growing seasons in Ontario.

Mandarin. Introduced into the United States from Manchuria in 1911. Seed yellow, medium to large; hilum yellow; plant bunchy, medium short;

flower purple. Suitable for seed and fodder in localities where seasons are short.

Cayuga. Originated in Manchuria. Seed small, black; hilum whitish; plant upright, medium height. An early variety which may successfully be grown as a concentrate feed in districts of Ontario having a medium length of growing season.

Minsoy. Selection by Minnesota Experiment Station, St. Paul, Minnesota. Seed yellow, medium sized; hilum brown; plant slender, erect, short; flower purple. An early variety well adapted for both seed and fodder to the shorter growing season localities of Ontario.

Hudson Heights (Hudson). A selection by T. B. Macaulay, Hudson Heights, Quebec. Seed yellow, small to medium size; hilum black; plant



A mixture of Soybeans and corn grown in Brant County.

bunchy, medium height. A mid-seasonal variety, high yielder, suitable to localities having a medium to short growing season.

O.A.C. No. 211. An O.A.C. selection from the Habaro variety. It is a popular variety in Ontario. Seed buff yellow, medium size; hilum yellow; plant erect, medium short, bushy; flower purple. A good yielder of both fodder and seed, suitable for grain production in the longer season sections and for fodder in most sections of Ontario.

Goldsoy. A high yielding, early maturing variety selected from O.A.C. No. 211 at the Ontario Agricultural College, and is similar to it in description. It may be successfully grown in sections of Ontario having shorter growing seasons.

Quebec No. 92. A selection at Macdonald College by Dr. L. S. Klinck. Seed yellow, large; hilum dark; plant bushy, short. An early variety adapted to shorter growing seasons of Ontario.

Manchu. Introduced into the United States from Manchuria, 1913. Seed maize colour, large; hilum black; plant erect, bushy, medium tall; flower purple. A high yielding fodder variety suitable to the longest growing season areas of Ontario.

Illini. Introduced from the College of Agriculture, Urbana, Illinois, 1927. Seed green, small; hilum brown; plant tall, erect; flower white. A late maturing plant especially recommended for table use as a dry bean.

SOYBEANS IN MIXTURES

Soybeans in mixtures add valuable proteins to the hay or fodder crop. Experiments at the Ontario Agricultural College involving soybeans in mixtures resulted in some very good yields of green fodder and hay. The soybean-corn mixture did not yield a greater tonnage than corn alone. To obtain the greatest tonnage these two crops should be grown separately and mixed as they are put into the silo. The following table shows some mixtures containing soybeans which have been tested at the College.

Table 3
Soybeans in Mixtures

Mixtures	Average of 6 years' Tests			
	Percentage When Harvested		Yield of Green Fodder (tons)	Yield of Hay (tons)
	Soybeans	Other Crops		
O.A.C. No. 211 Soybeans	100	....	11.12	3.70
O.A.C. No. 211 Soybeans and Early Amber Sugar Sorghum	43	57	18.95	6.81
O.A.C. No. 211 Soybeans and White Kaffir Corn	52	48	16.21	5.67
O.A.C. No. 211 Soybeans and Sudan Grass	29	71	13.28	4.65
O.A.C. No. 211 Soybeans and Japanese Panicle Millet	28	72	14.20	5.09
O.A.C. No. 211 Soybeans and Japanese Barnyard Millet	29	71	14.30	4.92
O.A.C. No. 211 Soybeans and Hungarian Grass Millet	21	79	9.29	3.66
O.A.C. No. 211 Soybeans and Teff Grass	58	42	10.83	4.03

ENEMIES OF THE SOYBEAN

In Japan, according to reports, there are many destructive diseases which attack the soybean. In the United States as yet no pest has assumed any great economic importance, but there have been some losses due to rabbits, woodchucks, root rot, cowpea wilt and caterpillars. Forty-three years of experiments at the Ontario Agricultural College have shown little loss due to fungus and bacterial diseases, but some parts of Ontario have reported that groundhogs show a preference for this crop. This comparative freedom from plant enemies is a favourable factor in promotion of soybean culture in Ontario.

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Ontario Department of Agriculture

Statistics and Publications Branch
TORONTO, ONTARIO

CONSERVE BY CANNING



THIS BULLETIN HAS BEEN PREPARED BY
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HOME ECONOMICS SCHOOL OF THE KEMPTVILLE
AGRICULTURAL SCHOOL

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Conserve by Canning

A well-stocked storage shelf of canned fruits and vegetables is an asset to every homemaker. It is economical, saving for future use food which otherwise would be wasted. It helps to meet such emergencies as unexpected guests. Most important of all, it promotes better nutrition and healthier families by ensuring throughout the whole year a liberal supply of some of those healthful foods which are so desirable.

Fruits and vegetables, raw and freshly cooked, help to regulate the body processes by supplying minerals, vitamins and bulk. They supply some food energy in a form that is easily used by the body. They act as appetizers, stimulating digestion by their colours, odours and flavours. While canned foods cannot replace entirely raw fruits and vegetables in food value, modern methods of canning will produce a product that compares favourably with the freshly cooked food. To get the full value of canned foods, make use of the liquid as well as the food itself. If it is not desirable to serve it directly with the food, save it for use in soups and sauces.

Many vegetables, such as carrots, beets and cabbage, may be stored successfully, and when carefully stored have a quality superior to the best canned product. Unless storage conditions are exceptionally poor it is not advisable to can such vegetables. Certain vegetables, such as green peas, beans and corn, cannot be stored, and the surplus from the garden may be canned.

Aims in Canning

- To prevent spoilage and preserve for future use.
- To preserve food value.
- To retain natural flavour.
- To retain natural colour and shape.

FOOD SPOILAGE

In successful canning spoilage is prevented by applying sufficient heat to destroy the spoilage agents, and by providing a perfect seal to prevent re-contamination. A knowledge of why foods spoil and how spoilage may be controlled will help in understanding the techniques used in the preparation, processing and storage of canned foods.

The acidity of foods, as indicated by their tartness, plays an important part in the control of spoilage. For this reason foods are grouped according to the amount of free acid they contain.

- Acid Foods—** Fruits (including tomatoes).
Pickled vegetables (addition of vinegar).

Non-acid Foods—All vegetables.

Tomatoes are classified botanically as fruits and are included as such in this bulletin.

SPOILAGE AGENTS

Enzymes

Chemical substances present in fruits and vegetables which bring about normal ripening. If they are permitted to continue their activity the fruit becomes over-ripe and finally decays.

Micro-organisms

Living bodies which are present in the air, soil and water but which cannot be seen by the naked eye. When growing actively they are readily destroyed by heat. But certain micro-organisms in their life cycle go through a dormant stage known as the spore form. At this stage they are very resistant to heat. Micro-organisms are grouped in three classes—*yeasts*, *moulds* and *bacteria*.

FORMS OF SPOILAGE AND THEIR CONTROL

Decay

Is indicated by darkening in colour and softening of tissues. It is caused by enzyme action, which is destroyed by heating to boiling temperature (212° F.).

Fermentation

Is indicated by gas bubbles and later a sour taste and odour. It is caused by the growth of yeasts, which are destroyed by heat (180° F.).

Mould

Is indicated by a fuzzy coating on the surface of the food. It is caused by the growth of moulds, which are destroyed by heating to boiling temperature (212° F.).

Bacterial Spoilage

Is indicated in various ways according to the particular type of bacteria which causes it. Bacteria are the most stubborn forms of micro-organisms with which to deal. They grow in both acid and non-acid foods. Most bacteria which grow in acid foods are readily destroyed by heat at 212° F. (boiling temperature). But bacteria which grow in non-acid foods form spores which are very resistant to heat. They have been known to resist heating for six hours at a temperature of 212° F. They are treated more effectively by a temperature of 240° F. for 30 minutes. Such a temperature can be obtained only by steam under pressure. This is the main reason for the use of a pressure cooker in canning non-acid foods.

Flat Sour

Some bacteria during their growth produce acids which are indicated by the sour odour and flavour of the food. To control flat sour do not let partially cooked food stand before processing, and thoroughly cool the product immediately after processing.

Putrefaction

Certain bacteria require free oxygen for growth—that is, they grow only in the presence of air. Others obtain oxygen from the food. In the process of tearing down the food to get oxygen they bring about rapid spoilage with the evolution of a large amount of gas. This is usually indicated by bad odours and softening and darkening of the food tissues and, if tin cans are used, by bulging cans. In some cases the gases formed are dissolved by the liquid and the only indication of their presence is the peculiar odour of the spoiled food.

Production of Toxin

"*Clostridium botulinum*" is a type of spore-forming bacteria whose spores are extremely resistant to heat. They may start to grow even after lying dormant for some time. During their growth they produce a toxin which, if eaten, will produce a condition known as botulism, with harmful effects, sometimes even causing death. If growth of these bacteria is well advanced there will be some indication of food spoilage as in putrefaction. But, unfortunately, toxin does not always reveal its presence by any sign that can be detected by casual observation.

The toxin itself, if heated sufficiently, will be rendered harmless. Therefore it is essential that, after opening, home-canned vegetables be boiled for 10 minutes before being tasted. We cannot be too cautious in the use of home-canned vegetables.



Boil All Home-canned Vegetables

CANNING METHODS

I. OPEN KETTLE

The "open kettle" was one of the earliest methods used in canning. The food is cooked in a kettle on top of the stove and transferred boiling hot to sterilized jars which are sealed immediately. Extreme care is necessary to keep the sterilized food and utensils free from spoilage agents while the jars are being filled.

This method is very satisfactory when evaporation is necessary as in the case of jams, jellies and conserves. It may be used for canning fruit but is not as satisfactory as the cooked-in-the-can method. The fruit tends to become too soft and lose its shape and it is difficult to avoid re-contamination by spoilage agents at some stage of the process. It must not be used for vegetables.

Directions for Open Kettle Canning

Avoid working with very large quantities. A kettle which holds five or six quarts of fruit is large enough to use. Work quickly.

1. Sterilize jars and utensils (see page 11).
2. Make syrup (see page 15).
3. Add fruit to boiling syrup and let cook until soft and thoroughly heated through.
4. Pour into sterilized jars. Fill to overflowing.

5. Remove air bubbles by sliding a sterilized fork or sterilized spatula along the inside of the jar. Refill with syrup.
6. Remove particles of food from the rim of the jar with a sterilized fork.
7. Seal tightly.

II. COOKED-IN-THE-CAN

The open kettle method is being replaced to a great extent by the cooked-in-the-can method, in which the food is packed into containers and processed.

Methods of Packing

Cold Pack—Suitable for fruits but not recommended for vegetables.

1. Fill clean jars with the uncooked fruit and cover with boiling syrup.
2. Fit on the rubbers and tops and partially seal. Screw the ring on tightly, then loosen one-eighth of a turn.

Hot Pack—Recommended for vegetables, very hard fruits or fruits of porous structure, such as strawberries.

1. Immerse the food in boiling liquid (water for vegetables, syrup for fruit) in an open kettle. Cook over direct heat until heated through but not soft. This is known as "pre-cooking".
2. Pack pre-cooked food into clean, hot jars and fill with boiling liquid. It is desirable to set jars in a pan of hot water while filling.
3. Fit on rubbers and tops and seal completely. Screw tops as tightly as possible.

Methods of Processing

The term processing refers to the actual cooking of the food in the jar to destroy spoilage agents. The length of time required is determined by the product and the processing method used.

Hot Water Bath

This method is satisfactory for fruits. When a pressure cooker is not available it may be used for vegetables but it is not recommended. Spoilage in canned vegetables is hard to control because certain bacteria which grow in vegetables may survive boiling temperature for a very long period (six hours or longer).

The jars, after being packed, are immersed in hot water in a canner and kept at boiling temperature (212° F.) for a sufficient length of time to destroy spoilage agents. A wash boiler or galvanized pail fitted with a rack and a tight cover makes a satisfactory canner. If buying a specially constructed canner, be certain that it is deep enough to allow for one or two inches of water above the jars. Experiments indicate that it may not be necessary to cover the jars with water but it is a precaution against spoilage. The water bath should be hot (not boiling) before the jars are put in.

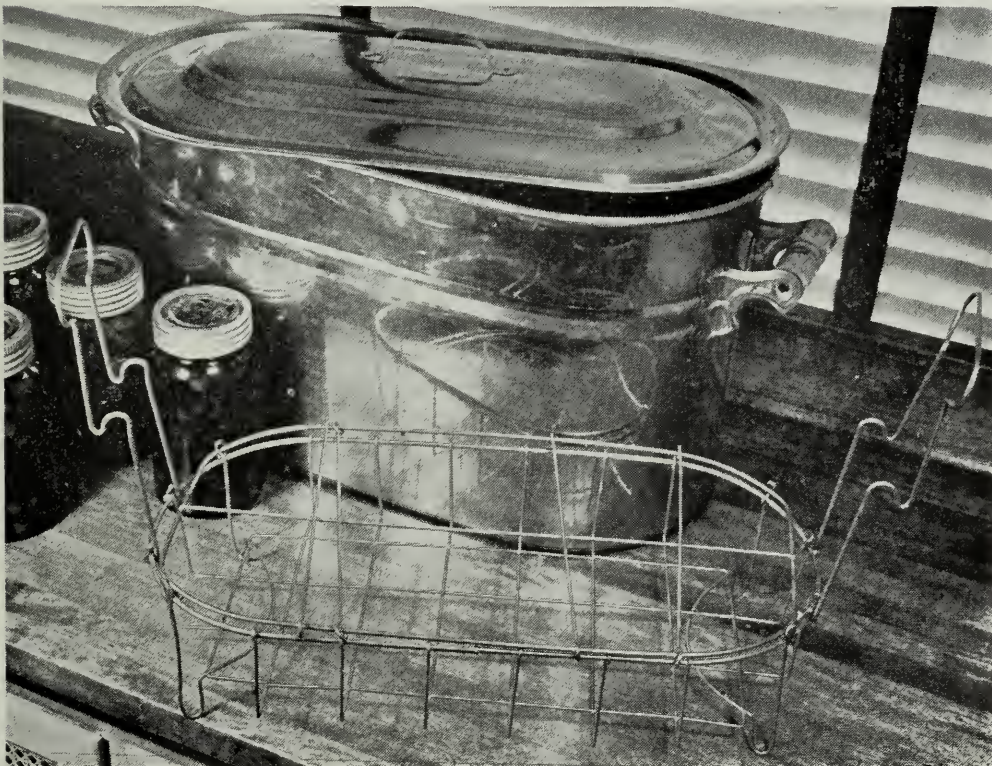
Directions for Hot Water Bath

Plan the work so that the bath is ready by the time the jars are packed.

1. Fit the rack into the canner.
2. Pack the jars according to the method of packing chosen.
3. Place the packed jars on the rack, allowing a half-inch space between the jars to permit free circulation of water. Be sure the water in the canner is deep enough to cover the jars with one inch of water.
4. Cover the canner with a well-fitting lid, heat to boiling and continue boiling for the full processing time. Count the processing period from the time the water comes to a rapid boil. If necessary add boiling water during the period to keep the jars covered.
5. Remove the jars from the bath immediately on completion of the processing period. Screw the tops as tightly as possible.



Hot Water Bath, One Burner Only, Using a Straight-sided Kettle and Rack



Hot Water Bath Using a Boiler and Rack

Pasteurization

This method is used for fruit juices only. The equipment is similar to that used for the hot water bath with the addition of an accurate thermometer. The filled bottles are immersed in a hot water bath which is kept at simmering temperature (170°-180° F.) for a specified period of time. All utensils used must first be sterilized (see page 11).

Pressure Cooker

The pressure cooker is a cast-aluminum vessel with a tightly-clamped cover and fitted with a pressure gauge, a pet-cock and a safety valve. The filled jars are heated in this cooker at a temperature above boiling point, produced by steam under pressure.



Steam Pressure Cooker Recommended for Vegetables

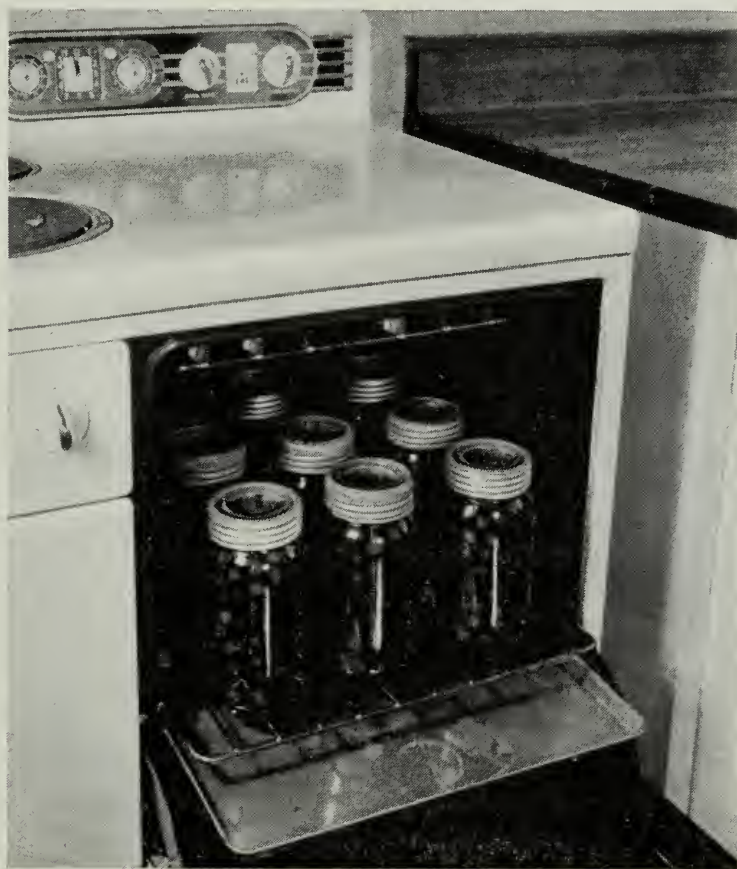
This method is highly recommended for vegetables. It is more destructive to bacteria and spores and it permits of a shorter processing period than does the hot water bath. It may also be used for fruits.

Directions for Pressure Cooker

Directions for use accompany each pressure cooker. Follow these closely. General directions are:—

1. Add hot water to the cooker to a depth of a half-inch above the rack.
2. Place the packed jars on the rack.
3. Place the cover on the cooker with the pet-cock open.
4. Screw the clamps gradually, fastening opposite clamps at the same time.
5. Heat until steam escapes freely from the pet-cock for at least five minutes and then close the pet-cock.

6. Continue heating until the desired pressure is indicated on the gauge and adjust the heat to keep the pressure constant for the entire processing time. This is important because variation in pressure will draw liquid from the jars.
7. Count the processing period from the time the gauge reaches the desired pressure.
8. When the period is completed, turn off the heat and cool until the gauge has been at zero for three to five minutes.
9. Open the pet-cock slightly—no steam should escape. If steam escapes when the pet-cock is opened liquid will be drawn from the jars.
10. Open the cooker by tipping the lid up at the opposite side. Remove the jars and tighten the tops at once.



Oven Processing with a Temperature-regulated Oven

Oven Processing

Because of the difficulty of keeping the heat uniform this method is restricted to use in a *well-insulated oven with an automatic heat control*.

The packed jars are placed on a rack in the oven, which is kept at a constant temperature throughout the processing period. All jars and utensils must first be sterilized. Tin cans cannot be used.

There is some disagreement as to the wisdom of using this method. The penetration of heat to the centre of the jar is slower than in other methods. This would indicate greater danger of spoilage and the need for a longer processing period. The method is satisfactory for some fruits, especially small fruits. Blueberries, cherries, raspberries and pineapple may be canned successfully in the oven. They seem to retain a freshness of flavour and texture not found when other processing methods are used. The oven must not be used for vegetables.

Directions for Oven Processing

1. Set the oven controls at 250° F. and pre-heat the oven.
2. Sterilize the jars and utensils (see page 11).
3. Pack the jars. Partially seal whether cold or hot pack method is used.
4. Place the packed jars on a rack two inches from the bottom. Allow space between the jars for free circulation of air. To prevent the fruit syrup from boiling out into the oven a tin pan or tray may be placed under the oven rack, with care not to obstruct the air vents.
5. Close the door and leave the jars for the entire processing period. Allow one and one-half times the period given for the water bath methods. Be sure the heat is kept constant.
6. When the period is completed, turn off the heat. Remove the jars at once and seal tightly.

CANNING STEP BY STEP

Successful canning requires a thorough understanding of each step and careful technique throughout the whole procedure.

Selection of Food

The quality of the canned product can be no higher than the quality of the raw food. Any unnecessary contamination increases the liability of spoilage.

Choose a product that is firm, well-matured, free from blemish and one that gives the least waste in preparation. Can the product immediately after gathering, if possible. This is especially important with vegetables.

Selection of Method

Choose a method that will give the best results for the food to be canned (see pages 5 to 10).

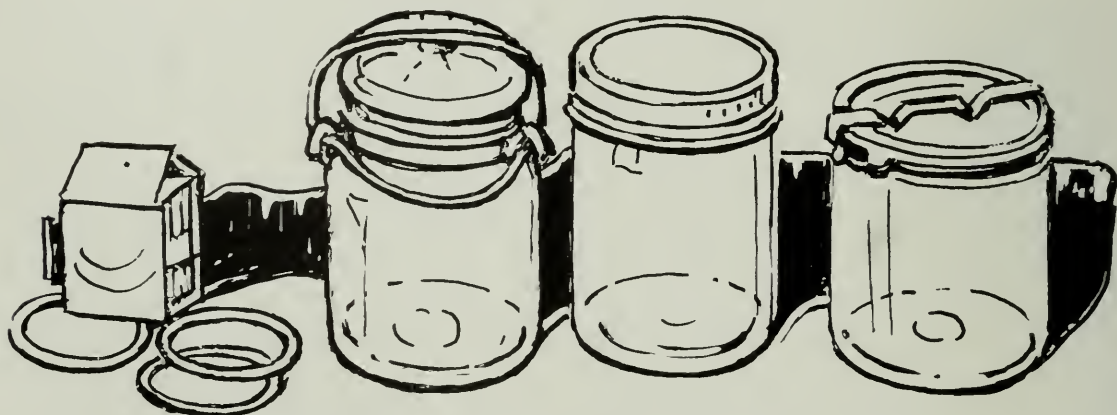
Selection of Equipment

Canners

Suitable for the method chosen.

Glass Jars

Choose jars simple in construction, with a wide mouth, fairly straight shoulders and a tightly fitting cover. The cover and rim should be free from cracks and chips. Jars should be of convenient size—pints or quarts. Two-quart jars may be used for fruits but not for vegetables.

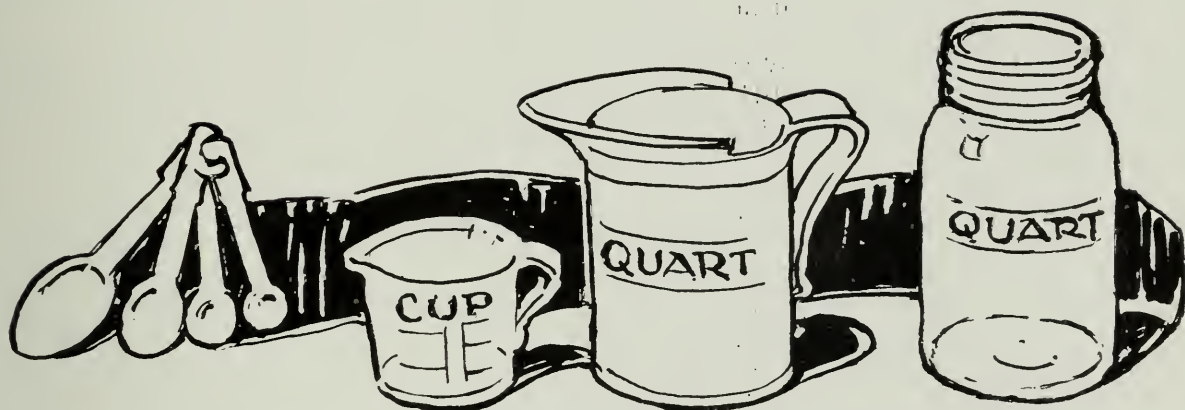


Spring Top, Zinc Ring or Vacuum Top Jars Are All Satisfactory

Rubbers

Choose rubbers of good quality which are firm, pliable and elastic. It is advisable to buy fresh rubbers each year.

TO TEST RUBBERS: When a rubber is bent back sharply on itself, there should be no signs of cracking. When stretched it should spring back to its original shape.



For Success — Use Standard Measures, All Wine or All Imperial

Accurate Measuring Utensils

Spoons, cups, quart measure. Be sure they are all the same standard size—either all wine or all imperial. The standard for most measuring cups and spoons on the market is wine measure.

Additional Equipment

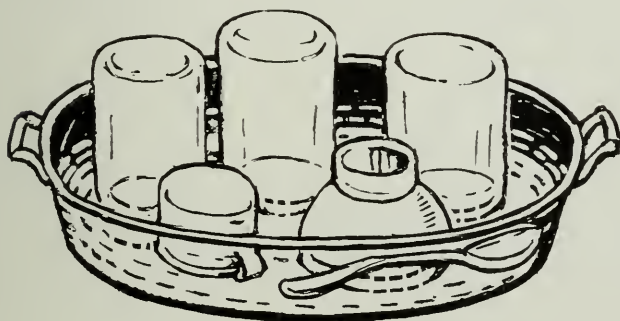
Knives—sharp, stainless, paring and French knives; spatula; stirring spoons—metal or wooden; wide-mouthed funnel; jar lifter; bowls; shallow pans; kettles for pre-cooking the food when this is necessary and for making the syrup; shallow pan for sterilizing the jars; wire basket for washing and blanching; supply of clean towels.

Preparation of Jars

To Test Jars for Leaks

Partially fill with warm water. Seal tightly and invert.

For processing by hot water bath or pressure cooker, jars should be clean and hot. Wash the jars and tops in warm, soapy water. Rinse in hot water. For the open kettle, oven and pasteurization methods, jars and utensils should be sterilized.



Open Kettle Method — Sterilize
Jars and Utensils

To Sterilize

Wash jars and tops in warm, soapy water. Rinse. Invert jars in two inches of water in a pan, e.g., a dish pan. A rack placed in the bottom of the pan will prevent the jars bumping. Immerse tops in the water. Also immerse

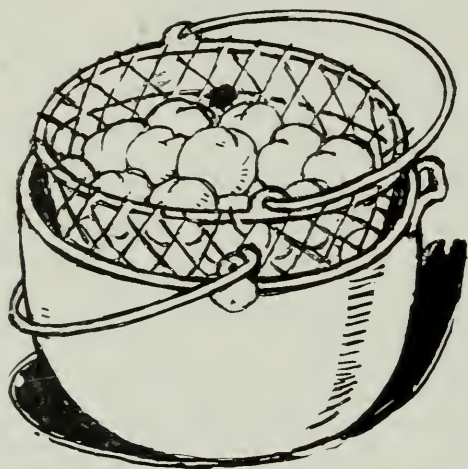
utensils used in handling the cooked food—funnel, cup, enamel plate, fork or spatula. Boil for 15 to 20 minutes. Immerse rubbers in boiling water for one minute.

Preparation of Food

Grade for uniformity of size and ripeness.

Wash food, using plenty of water. Be careful not to crush the food. Wash a small quantity at a time, lifting the food from the water rather than pouring off the water. A wire basket which can be dipped into a deep kettle of water is excellent for this.

Stem, pare or blanch as required. Peaches and tomatoes may be blanched.



A Wire Basket is Good for
Washing and Blanching

To Blanch Food

Lower a strainer or wire basket containing a small amount of fruit into a kettle of boiling water long enough to loosen the skin. The length of time required depends on the ripeness of the fruit. Plunge the scalded fruit into cold water to harden the pulp and make the fruit easier to handle. Remove skins at once.

To Prevent Discoloration

Peeled fruit, such as peaches, pears or apples, should be dropped into cold, salted water (one teaspoon of salt to one quart of water) or acidulated water (one teaspoon of lemon juice to one quart of water). Do not attempt a very large quantity at one time.

Preparation of Liquid

For fruits make syrup in advance and have it boiling when required (see page 15). For vegetables have a supply of boiling water on hand.

Packing the Jars

Follow directions for the method of packing to be used (see page 6). Work quickly. Do not pack too tightly as this will stop free circulation of the liquid.

Processing the Jars

Choose the most satisfactory method for the equipment available (see pages 6 to 10).

Cooling the Product

Remove the jars from the canner at the completion of the processing period.

Seal tightly, invert on a clean towel and examine for leakage.

Keep hot jars away from draught but cool as quickly as possible.

Do not attempt to tighten the tops after the jars are cold because this will break the seal. If the jars show signs of leakage they may be used at once or the contents may be heated, repacked in other containers and processed for five minutes.

Labelling and Storing

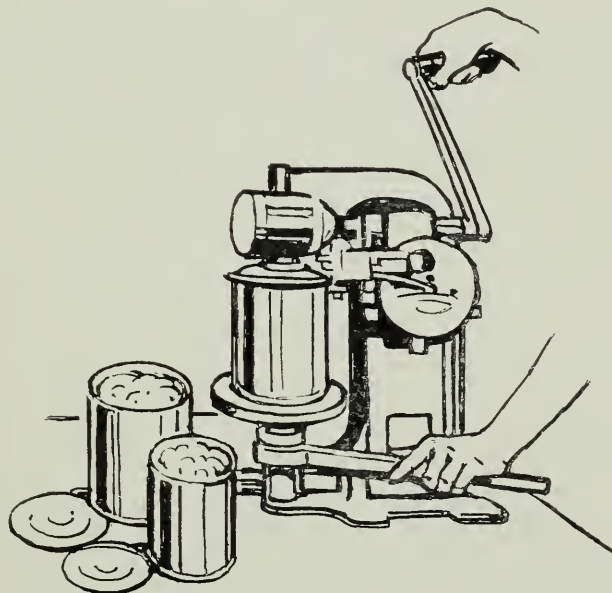
Wipe jars clean and label with the name, date and recipe identification.

Store jars in a cool, dry, dark place.

Canned foods may be kept indefinitely, but quality is generally better if they are used within twelve months.

THE USE OF TIN CANS

In home canning the use of tin cans similar to those used in commercial canning is becoming general. Excellent results have been obtained with both fruits and vegetables. Tins may be used for canning by the hot water bath and pressure cooker methods but not by the open kettle or oven methods.



Tin Can Sealing Machine

Because of discoloration of certain foods by the tin, specially-lined cans have been constructed for these foods — Sanitary or R. enamel for red-coloured foods, as beets, cherries, berries; C. enamel for foods containing sulphur, as

corn, beans and cauliflower; special enamel for a few products such as strawberries. Before purchasing cans become familiar with the types of cans and their uses. The manufacturers will supply this information. Order a size that will be economical for home use and state what foods are to be canned.

A sealing-machine must be purchased as well as the cans and tops. Hand-operated machines which have proven satisfactory are available. Full directions for operating are given with the machines.

For detailed instructions on the preparation of food, exhausting and processing times for canning in tin, see the bulletin, "Home Canning of Fruits and Vegetables in Tin Cans", by R. W. Arengo-Jones, Division of Horticulture, Experimental Farm, Ottawa, Publication 533.

Canning of Fruit

Fruits may be canned by several methods but the hot water bath is the most successful. Follow the directions given under the method chosen. Use syrup as the liquid to fill the jars.

TABLE 1 — SYRUP USED FOR FRUITS

Type	Sugar	Water	Amount of Syrup	Method
Thin.....	1 ½ cups	3 cups	3 ½ cups	Measure sugar and water. Stir until sugar is dissolved. Boil for one minute.
Medium.....	2 cups	2 cups	3 cups	
Heavy.....	3 cups	1 ½ cups	3 cups	

The amount of syrup required for each jar varies with the size of the fruit and the tightness of the pack, but an approximate estimate can be made.

To each quart jar allow:

For Large Fruit—Two cups of syrup.

For Small Fruit—One cup of syrup.

Most measuring cups on the Canadian market are wine measure. If imperial jars are used, more syrup will be required to fill them.

CANNING FRUITS WITHOUT SUGAR

Fruits may be canned without sugar but the shape, colour and flavour are retained better when sugar is added.

For such juicy fruits as berries, cherries and currants, it is advisable to use hot fruit juice as the liquid to replace the syrup. The juice may be extracted from over-ripe or crushed fruit. For less juicy fruit, as apples, peaches and pears, use boiling water to replace the syrup.

TABLE 2 — CANNING OF FRUITS

NOTE—The method which was found most satisfactory in the experimental work carried on in preparing this bulletin has been placed first in each case.

Fruit	Preparation	Method	Syrup	PROCESSING PERIOD	
				Hot Water Bath, 212° F., Minutes	Steam Pressure 5 lbs., Minutes
<i>Apples</i> Use sound, slightly under-ripe, tart apples.	Pare, core, cut into quarters or size desired. To prevent darkening, drop into salted water (1 teaspoon salt to 1 quart water).	I. Hot Pack—Pre-cook in boiling syrup 5-10 minutes, depending on the hardness and variety of the fruit. Early varieties require less pre-cooking than later ones. Fill jars with apples. Cover with boiling syrup. Seal and process.	Thin	5	5
		II. Cold Pack—Pack raw fruit into jars. Cover with boiling syrup. Partially seal and process.	Thin	15-25	8-10

TABLE 2—CANNING OF FRUITS (Continued)

Fruit	Preparation	Method	Syrup	PROCESSING PERIOD	
				Hot Water Bath, 212° F., Minutes	Steam Pressure 5 lbs., Minutes
<i>Apple Sauce</i>	As for apples.	Hot Pack—Cook in water until soft. Sweeten to taste. Fill sterilized jars. Seal. As an added precaution, process 5 minutes in hot water bath.		5	Not recommended.
<i>Blueberries</i> ...	Clean, pick over and wash.	I. Cover with boiling water for 5 minutes. Drain. Fill jars with fruit. Cover with boiling syrup. Add 1 teaspoon lemon juice to each quart of berries if desired. Partially seal and process. II. Open Kettle—To 3 cups berries add ½ cup rhubarb cut in ½-inch lengths or 3 teaspoons lemon juice, 2 cups sugar and ½ cup water. Simmer until berries are soft. Fill sterilized jars. Seal tightly.	Medium	20	5-10
<i>Cherries</i> <i>Sweet or Sour.</i>	Wash cherries. Remove stems. Pit, if desired. It is usually preferable to pit sour cherries. Sweet ones are good for salads if unpitted. A sterilized paper clip or wire hairpin may be used for a cherry pitter. Unpitted cherries should be pricked with a fork.	I. Cold Pack—Pack cherries in jars. Cover with hot syrup. Partially seal and process. II. Oven Processing at 275° F. for 35 minutes gives good results with cherries.	Medium	25	10
<i>Citron</i>	Remove seeds. Cut in cubes. Let stand over night in weak brine (¼ cup salt to 1 quart water). Drain. Cover with clear water. Let stand 4 hours. Drain.	Open Kettle—To 2 cups heavy syrup add 2 cups diced citron, ¼ lemon, sliced; 1 teaspoon preserved ginger, chopped. Cook until tender. Pour into sterilized jars. Seal.	Heavy		
<i>Crabapples</i> ...	Cut out blossom end and blemishes. Leave whole. Prick skins with fork.	I. Hot Pack—Pre-cook 5 minutes in boiling syrup. Pack in jars. Cover with hot syrup. Seal and process. II. Cold Pack—Pack raw fruit into jars. Cover with boiling syrup. Partially seal and process.	Medium	15-20	10
			Medium	30	12-15
<i>Currants</i> <i>Black.</i>	Remove stems and blossom hulls. Wash.	Open Kettle No. 1—(satisfactory because of the strong flavour of the fruit). To 1 cup currants add 1 cup cold water and 2 cups sugar. Cook slowly until the currants are soft. Pour into sterilized jars. Seal tightly.			

TABLE 2 — CANNING OF FRUITS (*Continued*)

Fruit	Preparation	Method	Syrup	PROCESSING PERIOD	
				Hot Water Bath, 212° F., Minutes	Steam Pressure 5 lbs., Minutes
<i>Currants, Black (Cont'd)</i>		Open Kettle No. 2 (gives a thicker, jelly-like consistency). To 4 cups currants use 1 cup water and 4 cups sugar. Add water to currants. Bring slowly to boiling point. Cook until tender but not broken. Add sugar and boil 2 minutes. Pour into sterilized jars. Seal tightly.			
<i>Currants..... Red.</i>	Remove hulls and stems. Wash.	Hot Pack—Pre-cook in hot syrup 15-20 seconds, or until they shrink. Fill jars. Partially seal, and process.	Medium	15	5
<i>Gooseberries..</i> May be canned when slightly under-ripe.	Cut off stems and blossom ends with scissors. Wash. Prick each berry with a fork.	Hot Pack—Pre-cook in hot syrup 15-20 seconds. Fill jars. Cover with hot syrup. Partially seal, and process.	Heavy	15	8
<i>Grapes.....</i> Blue grapes may be canned	Remove from clusters. Wash carefully. Remove pulp from skins. Cook pulp until soft. Put through a sieve to remove seeds. Add skins.	Open Kettle—To 4 cups grape pulp and skins add 2 cups syrup. Bring to a boil. Fill sterilized jars. Seal tightly.	Medium		
<i>Peaches.....</i> Use fully-ripe fruit to obtain the best flavour.	Blanch by plunging into boiling water for 30-60 seconds or until the skins will wrinkle. Dip at once into cold water. Remove the skins quickly. If peaches are free-stone, cut in halves and remove pits. If not, peaches may be left whole. To prevent darkening, drop into cold, salted water (1 teaspoon salt to each quart water).	I. Hot Pack — (Gives better pack than Cold Pack). Pre-cook by simmering in boiling syrup 4-8 minutes, depending on their ripeness, but do not cook until soft. Pack, placing the halves pit side down in overlapping layers. Cover with boiling syrup. Seal and process. II. Cold Pack—(Gives slightly darker colour than hot pack.) Pack the raw fruit into jars. Cover with boiling syrup. Partially seal and process. III. Open Kettle — Cook in boiling syrup. Fill sterilized jars. Seal tightly.	Thin or medium. To improve flavour, one cracked pit may be added for each quart of syrup.	15	10
<i>Pears.....</i>	Should be picked while green and allowed to ripen in storage. Can when fully ripe. Peel, cut in halves, and core. Drop into cold, salted water (1 teaspoon salt to each quart of water).	I. Hot Pack—Pre-cook 1-4 min. in hot syrup. Pack in jars. Seal and process. II. Cold Pack — Pack the raw fruit into jars. Cover with boiling syrup. Partially seal and process. Oven Processing—250° F. for 75 minutes gives good results with pears.	Thin or Medium Thin or Medium Thin or Medium	15 20-25	8 8

TABLE 2—CANNING OF FRUITS (Continued)

Fruit	Preparation	Method	Syrup	PROCESSING PERIOD	
				Hot Water Bath, 212° F., Minutes	Steam Pressure 5 lbs., Minutes
<i>Pineapple</i>	Peel, core, remove eyes, and cut in cubes.	I. Open Kettle (gives an excellent flavour). Add diced pineapple to boiling syrup. Cook until soft. Fill sterilized jars and seal tightly. II. Cold Pack—Pack the diced, raw fruit into jars. Cover with boiling syrup. Partially seal and process.	Medium Medium	 30	 25
<i>Plums</i>	Plums are usually canned whole. Wash and prick with a fork. Some people prefer to remove skins. To do this, dip in boiling water one minute. Remove, let stand a few minutes. Remove skins. Do only a few at a time and work quickly to prevent plums turning brown.	I. Hot Pack—Pre-cook in boiling syrup five minutes. Fill jars. Cover with syrup. Seal and process. II. Cold Pack—Pack into jars. Cover with boiling syrup. Partially seal and process.	Medium or Heavy Medium or Heavy	15 20	5
<i>Raspberries</i> ..	Pick over berries. Wash.	I. Cold Pack—Fill jars with raw berries. Cover with boiling syrup. Partially seal and process.	Medium	20	10
<i>Rhubarb</i>	Select young tender stalks. Wash and trim, but do not remove skin. Cut into $\frac{1}{2}$ to $\frac{3}{4}$ -inch lengths.	I. Pack rhubarb in jars. Cover with boiling syrup. Partially seal and process. II. Use $\frac{1}{2}$ cup sugar to each pint jar. Put a thin layer of sugar in the bottom of pint jars, then alternate layers of rhubarb and sugar with a layer of sugar on top. Pack very tightly, using a wooden masher. Crushing the rhubarb does not impair the finished product. Partially seal and process.	Heavy	20 25	5 10
<i>Rhubarb Sauce</i>	As for rhubarb.	Add enough water to the rhubarb to prevent burning. Cook until soft. Add sugar to taste (approximately 1 cup sugar to 1 quart raw fruit). Fill sterilized jars. Seal tightly. An added precaution is to process 5 minutes in a hot water bath.		5	
<i>Strawberries</i> .	Working with small quantities gives best results with strawberries. Hull berries and wash carefully.	I. Cold Pack—Pack berries in jars. Cover with boiling syrup. Partially seal and process. II. Hot Pack—Pre-cook by adding strawberries to hot syrup. Cook 5 minutes. Let stand 3-5 hours. Bring to boil and fill jars. Seal and process. Oven Processing is not satisfactory with strawberries.	Medium to Heavy Medium to Heavy	20 5	10

TABLE 2—CANNING OF FRUITS (Continued)

Fruit	Preparation	Method	Syrup	PROCESSING PERIOD	
				Hot Water Bath, 212° F., Minutes	Steam Pressure 5 lbs., Minutes
<i>Thimble-berries.....</i>	Wash and pick over berries.	Cold Pack—Pack berries in jars. Cover with boiling syrup. Partially seal and process.	Thin or Medium	25	10
<i>Tomatoes.....</i>	Select firm, ripe tomatoes of medium size. Wash. Blanch by immersing in boiling water for about one minute. Plunge into cold water and peel at once.	I. Cold Pack—Pack the raw tomatoes into jars. Add 1 teaspoon salt to each quart jar. Cover with boiling water or tomato juice. Partially seal and process.	Boiling water or tomato juice	30	10 lbs. pressure 4 min.
		II. Hot Pack—Simmer 3 to 5 minutes. Fill jars. Add 1 teaspoon salt to each quart jar. Cover with boiling water or tomato juice. Seal and process.	Boiling water or tomato juice.	20	5 lbs. pressure 8 min.

CANNED FRUIT JUICES

Canned fruit juices served in such forms as beverages, appetizers, gelatin salads, sherbets and pudding sauces may be used to add variety to winter menus. Cherry, currant, elderberry, grape, rhubarb, raspberry and tomato juice all may be canned successfully.

The best results are obtained by keeping the fruit and the extracted juices below the boiling point, since boiled juice has a poor colour and flavour. Pasteurization is the method to use for canned fruit juices (see page 8).

Use fully ripe, sound, clean fruit. Immature fruit will give a harsh-flavoured juice and unwashed or decayed fruit a juice of undesirable flavour. If possible do not use crushed or bruised fruit, because this favours growth of micro-organisms and allows the enzymes to produce decay more rapidly. After being picked, grapes should stand two or three days to mellow the juice. The addition of sugar is optional but it improves the colour of the juice.

To Extract the Juice

(a) With Addition of Sugar

For soft fruits, as berries and grapes, wash and stem the fruit. Crush with a potato masher or wooden spoon. To 3 pints berries add 2 cups medium syrup. Let stand 2 hours. Heat over a pan of water, e.g., a large double boiler, at 180° F., until the colour is diffused throughout the mass.

For hard fruits, as rhubarb, cut in small pieces. To 4 cups fruit add 2 cups medium syrup. Simmer for 10 to 15 minutes.

(b) Without Addition of Sugar

Prepare fruits as in (a). For soft fruits add $\frac{1}{4}$ cup water to each cup of fruit. For hard fruits add $\frac{1}{2}$ cup water to each cup. Cook slowly in a covered kettle until soft.

Pour the heated fruit into a press or a cotton jelly bag. Press immediately. Use a uniform pressure which is increased slowly. Hard pressing increases the amount of colour and total solids.

To Clarify the Juice

Strain through a thin cloth or four layers of cheese cloth.

NOTE: For tomato juice, pre-cook at 170°-180° F. Put through a sieve and do not clarify. Add salt in place of sugar, allowing 1 teaspoon salt per quart of juice.

To Bottle the Juice

Reheat the juice to 170°-180° F., stirring constantly. Pour into sterilized jars or bottles, being sure the containers are completely filled. Sterilize tops and rings or bottle caps. Adjust tops, seal tightly and process. If corks are used, tie tightly with string. Dip in melted paraffin after pasteurizing.

To Process:

Immerse jars or bottles in water bath at 170°-180° F. for 20 to 30 minutes. For apple juice 10 minutes is sufficient, but it is difficult to extract apple juice without special equipment for milling and pressing.

To Cool:

Cool bottles by first running lukewarm water over them and following this with cold water.

CANNED FRUIT BUDGET FOR FAMILY OF SIX

Allow 6-8 servings per quart of fruit.

Six months of the year with no fresh fruit except apples and imported fruits, serve canned fruit six times a week.....	144 quarts
Four months of the year supplement raw fruit with canned fruit three times a week.....	48 quarts
Four months of the year no raw apples, serve canned apples once a week.....	16 quarts
	208 quarts

This is only an estimate. It should be adjusted to meet the specific need according to the amount and kind of raw fruit produced on the farm and also according to the preferences of the family and to the prices and quality of fruit on the market which will vary from year to year.

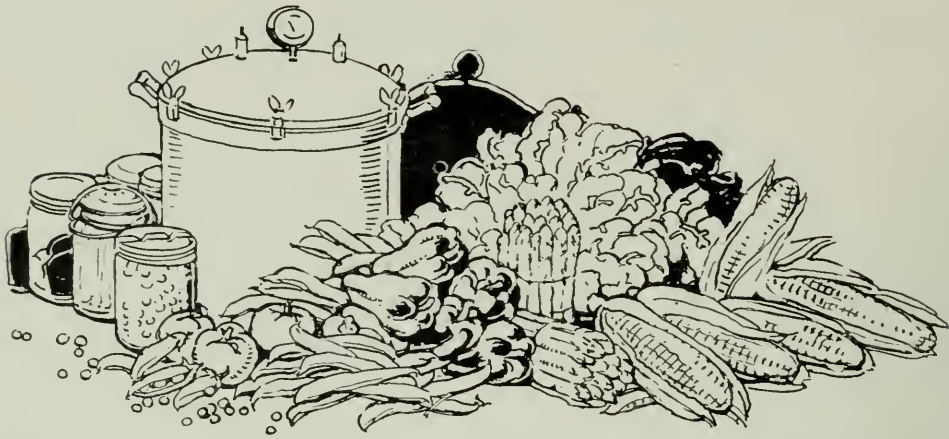
TABLE 3 — APPROXIMATE YIELD OF CANNED PRODUCT FROM RAW FRUIT

Fruit	Quantity of Raw Fruit	Approximate No. of Quarts (Wine Measure) of Canned Fruit
<i>Apples or Applesauce</i>	1 bushel.....	16-20 quarts
<i>Berries:</i>		
Blueberries.....	1—6-quart basket.....	4 quarts
Raspberries.....	1 quart box.....	1 quart
Strawberries.....	1½—2-quart box.....	1 quart
Thimbleberries.....	1 quart box.....	1 quart
<i>Cherries</i> (Sour).....	1—11-quart basket.....	8 quarts
(Sweet).....	1—6-quart basket.....	4 quarts
<i>Black Currants</i>	1—6-quart basket.....	6 quarts
<i>Peaches</i> (halves).....	1—11-quart basket.....	8 quarts
<i>Pears</i> (halves).....	1 bushel.....	13 quarts
<i>Pineapple</i>	4—sizes Nos. 16 or 18.....	4 quarts
<i>Plums</i>	1—11-quart basket.....	9 quarts
<i>Grapes</i> (Blue).....	1—6-quart basket.....	4-5 quarts

STANDARDS FOR JUDGING CANNED FRUIT

Qualities of Standard Product	Common Faults	Possible Cause
<i>Container</i> Suitable size and shape for product. Easy to clean, fill and empty. Perfectly sealed. Label—neat, suitable size, well placed, adequate information.	Mouth too small. Broken seal. Too large or too small. Poorly placed. Information lacking.	
<i>Contents</i> Pack— Uniform size and shape. Solids evenly distributed. Best use of space. Good proportion of solids to liquids.	Solids float..... Too much shrinkage..... Jars not full..... Too much liquid for solids..... Too little liquid.....	Fruit contains air—overcome by pre-cooking. Over-cooked. Too heavy a syrup. Fruit not pre-cooked. Too loose a pack. Careless packing. Container not covered with water in bath.
<i>Colour</i> Natural, bright, uniform.	Too dark..... Faded..... Uneven colour..... Dark at top of container..	Overcooking. Stood too long before packing. Fruit canned in water. Fruit immature. Pre-cooked too long. Uneven ripeness. Stood too long before packing. Iron in water. Air present in container during or after processing. Lack of liquid.
<i>Liquid</i> Bright, natural colour of fruit. Clear.	Cloudy..... Floating particles or seeds. Bubbles.....	Over-ripe fruit. Careless preparation. Over-cooking. Air not allowed to escape before sealing. Indication of spoilage.
<i>Flavour</i> As nearly as possible like flavour of raw fruit.	Tasteless..... Too sweet or too tart..... Caramelized.....	Fruit under-ripe. Canned in water or too thin a syrup. Wrong syrup for fruit. Over-cooking.
<i>Texture</i> Tender, yet firm enough to hold shape.	Hard, tough, fibrous..... Soft or mushy..... Shrunken.....	Under-ripe. Under-cooking. Over-ripe. Crushed in packing. Over-cooking. Too heavy syrup. Over-cooking.

Canning of Vegetables



PRECAUTIONS AGAINST SPOILAGE

Can vegetables not longer than two hours after gathering.

Gather and can only small quantities at one time. Spoilage often occurs before canning.

Clean thoroughly, removing all particles of soil.

Use pint or quart jars or cans. *Two-quart jars must not be used.*

Pre-cook until thoroughly heated through. Work quickly and do not let vegetables cool after pre-cooking.

Pack vegetables loosely.

Caution:

Discard vegetables when there is the slightest indication of spoilage. Bury very deep or burn. Do not throw to chickens or pigs.

CAUTION:

Before tasting, boil for 10 minutes all home-canned vegetables not processed in a pressure cooker.

TABLE 4 — CANNING OF VEGETABLES

Vegetable	Preparation	Method	PROCESSING PERIOD	
			Pressure Cooker	Hot Water Bath, 212° F.
<i>Asparagus</i>	Select tender stalks. Wash thoroughly, using a stiff brush. Be sure that no soil is lodged under the scales. An added precaution is to remove the scales along the stalks. Sort as to size and tie in bundles. Cut into lengths to fit pint jars. Asparagus may be cut in $\frac{3}{4}$ -inch lengths instead of the longer stalks.	Stand upright in 2 inches of boiling water. Cook uncovered 4-5 mins. Pack boiling hot into jars. Pack stalks tips up except in centre of jar, where 2 or 3 stalks may be packed tips down. To each pint add $\frac{1}{2}$ teaspoon salt. Add the boiling liquid in which the asparagus was cooked, filling jars to within $\frac{1}{2}$ inch of top. Boiling water may be used to make up the amount of liquid required. Seal and process.	10 lbs. pressure, 35 mins.	3 hrs.

TABLE 4 — CANNING OF VEGETABLES (*Continued*)

Vegetable	Preparation	Method	PROCESSING PERIOD	
			Pressure Cooker	Hot Water Bath, 212° F.
<i>Beans</i> Fresh, Lima.	Shell, wash carefully.	Blanch in boiling water 4-6 mins. Drain. Pack loosely in jars. Add ½ teaspoon salt to each pint. Cover with boiling water. Seal and process.	10 lbs. 50 mins.	3 hrs.
<i>Beans</i> String, green or yellow.	Leave beans whole or cut in 1-inch lengths.	Cover with boiling water. Let boil 5 mins. in an uncovered kettle. Drain. Pack into jars while hot. Add ½ teaspoon salt to each pint. Cover with boiling water. Seal and process.	10 lbs. 50 mins.	3 hrs.
<i>Beets</i>	Small, tender beets may be canned early in the season when thinning the rows. Cut off tops to within one inch of the beet crown. Wash. Leave small beets whole. Slice or dice large beets.	Boil in water to cover till the skin slips off easily (15 mins.). Plunge into cold water. Remove tops and skins. Grade for size. Pack into jars. Do not add salt to beets. Fill jars with boiling water. Partially seal and process.	10 lbs. 30 mins.	1 ½ hrs.
<i>Carrots</i>	Use very small, tender carrots. Wash thoroughly. Scrape off skin.	Cover with boiling, salted water (1 teaspoon salt to each quart water). Boil 3-5 mins. Dip in cold water 1 min. Pack upright in jars, alternating stem and root ends. Fill with boiling liquid. Seal and process.	10 lbs. 35 mins.	2 hrs.
<i>Corn</i>	Husk corn and remove silk.	Cut kernels from cobs. Cover with boiling water. Add ½ teaspoon salt and 2 teaspoons sugar for each quart. Bring just to boiling point. Fill jars. Seal and process.	15 lbs. 75 mins.	3 hrs.
<i>Green Peas</i>	Use only young, tender peas. Shell and wash.	Blanch 3 to 10 mins., depending on the age of the peas, until the skin wrinkles but does not burst. Remove and dip in cold water. Pack lightly in jars. Add ½ teaspoon salt to each pint. Fill jars with boiling water. Partially seal and process. Peas are difficult to can successfully by the hot water bath.	10 lbs. 45 mins.	3 hrs.
<i>Pimientos</i> (Good for salad garnishes).	Wash. Remove stem ends and seeds.	Cover with boiling water for 2 mins. Drain. Place in ice-cold water for 2 mins. Remove skins. Cut into quarters or strips. Cook in boiling water until tender. Pack into sterilized jars. Cover with hot vinegar solution (2 cups vinegar, 1 cup sugar). Seal tightly.		
<i>Pumpkin</i>	Wash. Remove seeds and peel. Cut in ¾-inch cubes.	Cook in a small quantity of water until soft. Put through a sieve (pumpkin should be soft enough to flow from the can when inverted). Reheat to boiling point. Fill jars. Seal and process.	15 lbs. 60 mins.	3 hrs.

TABLE 4 — CANNING OF VEGETABLES (Continued)

Vegetable	Preparation	Method	PROCESSING PERIOD	
			Pressure Cooker	Hot Water Bath, 212° F.,
<i>Squash</i>		Method No. 1. Proceed as for pumpkin. Method No. 2. Cut into halves. Bake at 400° F. till tender. Scrape out pulp. Put through a sieve. Add 1 teaspoon salt to each quart. Mix thoroughly and heat to boiling. Pour into jars. Seal and process.	15 lbs. 60 mins.	3 hrs.
<i>Spinach</i>	Pick over leaves carefully. Wash 3 or 4 times. Use plenty of water. Lift out the greens each time. Shred as for cooking.	Heat in an uncovered kettle with a very small amount of water over low heat until wilted. Stir while heating. Pack into jars. Add ½ teaspoon salt to each pint. Cover with boiling water. Partially seal and process.	10 lbs. 60 mins.	3 hrs.

TABLE 5 — APPROXIMATE YIELD OF CANNED PRODUCT FROM RAW VEGETABLES

Product	Quantity of Raw Vegetables	Approximate Yield as Canned Product
<i>Asparagus</i> (whole).....	1—11-quart basket.....	7 pints
<i>Fresh Lima Beans</i>	1—11-quart basket.....	6 pints
<i>Beans, Snap</i>	1—11-quart basket.....	12 pints
<i>Beets</i>	1—11-quart basket.....	12 pints
<i>Carrots</i>	1 bushel.....	36 pints
<i>Corn</i> (Golden Bantam).....	10-12 ears.....	2-3 pints
<i>Greens</i>	1 bushel.....	10-12 pints
<i>Peas</i> (in pods).....	1 bushel.....	8 pints
<i>Tomatoes</i>	1 bushel.....	30-36 pints (16 quarts)

The kind and amount of vegetables canned will vary with the equipment available, the size of the garden and the facilities for storage. For this reason no vegetable budget is included in this bulletin.

VEGETABLE PUREES

Canned vegetable purees are convenient for making plain or cream soups. Special attention must be paid to the detection of spoilage and to the precautionary measure of boiling 10 minutes before tasting.

The purees may be made of one vegetable or of such combinations as carrot, celery and beet; tomato and celery; tomato and carrot; potato, carrot and onion. The vegetables are cooked until soft with as little water as possible and put through a sieve while hot. Vegetables such as potatoes, carrots and beets may be put through a ricer. Use half-pint jars for canned purees. They are more practical and there is less danger of spoilage.

General Directions

Cook vegetables. Put through a sieve. Add salt (1 teaspoon to a pint). Heat to boiling. Pack while hot into half-pint jars. Seal and process in a pressure cooker at 15 pounds pressure for 40 minutes. Combinations of vegetables require 60 minutes, except a combination of asparagus and peas, which requires only 40 minutes.

Jelly

Jelly-making is an art. What a delight it is to see a glass of sparkling jelly which is "just right"! What a disappointment when the jelly is gummy or leathery or does not set!

Success is not a matter of luck. It is a matter of knowledge. To make a good fruit jelly one must know what is essential for the formation of the jelly and the conditions which best control the results.



Use Small Quantities to Secure Good Jelly

FACTORS IN JELLY-MAKING

Pectin

Pectin is the constituent of fruit which gives jelling properties to the juice. It is found under the peel and around the core and is more abundant in slightly under-ripe fruit than in either green or over-ripe fruit. The pectin content of fruit juices varies from time to time with the variety of fruit, the degree of ripeness, the season and the locality in which the fruit is grown. Hence it is necessary to test the juice for pectin each time jelly is made.

Pectin is readily dissolved in liquid by heat, so juice from cooked fruit contains more pectin than the raw fruit juice. But cooking fruit juice at boiling temperature for prolonged periods tends to destroy the pectin. Hence, in preparing the juice, cook the fruit at simmering temperature. Do not boil.

Acid

Fruit acids play an important part in the extraction of pectin and in the setting of the jelly. A definite amount of acid is necessary for good jelly.

Fruits vary in their acid content as indicated by their tartness. For a practical test in the home, taste the juice and compare it with a mixture of one teaspoon of lemon juice and eight teaspoons of water. If the juice is low in acid, add lemon or other tart fruit juice, as currant or gooseberry.

Water

Water is essential because it dissolves the pectin and makes possible its extraction from the fruit pulp. It is present to some extent in all fruits but more so in juicy varieties. Some fruits require additional water for cooking.

Sugar

Sugar is added to the fruit juice to improve the texture, flavour and yield of the finished product. The amount of sugar required to give a good jelly varies with the pectin content of the fruit juice (see Table 6). In jelly, pectin forms a network holding the syrup within its mesh. Its capacity for holding the syrup is limited and if too much sugar has been added for the amount of pectin, the syrup will break away from the network. Sometimes this causes complete failure but often the syrup oozes out after the jelly has been stored. Other conditions being equal, too much sugar gives a weak jelly and too little sugar a tough one.

It has been found that sugar added to the juice prevents the destruction of the pectin. Experiments indicate that boiling the fruit juice prior to adding the sugar reduces the strength of the jelly, but boiling for a long time in the presence of sugar does not affect it. Therefore the sugar is added to the fruit juice before boiling (see directions, page 28).

TABLE 6 — CLASSIFICATION OF FRUITS ACCORDING TO JELLYING PROPERTIES

Sufficient Pectin Sufficient Acid	Sufficient Pectin Low in Acid	Low in Pectin Sufficient Acid	Low in Pectin Low in Acid	Not Good for Jelly but Good for Jam
Sour Apples Currants Cranberries Gooseberries Grapes (Concord) Sour Plums	Mild-flavoured apples (crab- apples) Blueberries Oranges Sweet Plums Quinces Raspberries	Sour Cherries	Elderberries Pears Pineapple Strawberries	Apricots Peaches Plums (occasionally) Strawberries

DIRECTIONS FOR MAKING GOOD JELLY
Preparing the Fruit

1. Study Table 6. Fruits in the first two columns make good jelly without additional pectin.
2. Use a mixture of ripe and slightly under-ripe fruit in the proportion of 1 cup ripe to 2 cups under-ripe to give good flavour and colour as well as maximum pectin.
3. Wash and remove stems and blemishes. Do not peel or core.
4. If fruit is low in acid, add lemon juice to the raw fruit. Mash the fruit or cut into small pieces. Measure. To each quart of raw fruit add:

For ripe apples.....	6 tablespoons lemon juice
“ crabapples.....	4-6 tablespoons lemon juice
“ blueberries.....	¼ cup lemon juice
“ oranges.....	½ cup lemon juice
“ plums (sweet).....	½ cup lemon juice
“ quince.....	½ cup lemon juice
“ raspberries.....	¼ cup lemon juice

Instead of adding lemon juice, these fruits may be used in combination with tart fruits, e.g., blueberry with rhubarb; raspberry with red currant; strawberry with gooseberry.

5. Cook the fruit. Pay careful attention to the amount of water added. If the fruit juice is too thin the prolonged heating necessary to concentrate it destroys some of the pectin and the flavour (see Table 7).

Table 7 — Cooking Fruit for Extraction of Juice

Type of Fruit	Preparation	Water per Quart of Fruit	Method of Cooking
<i>Soft</i> Blueberries Grapes Raspberries	Mash.	1 cup	Add water. Heat slowly to simmering point. Do not boil. Cook until very soft and mushy.
<i>Medium</i> Currants Gooseberries Plums	Mash or cut.	2 cups	As above.
<i>Hard</i> Apples Crabapples	Cut into pieces.	4 cups	As above.
<i>Very Hard</i> Quince	Cut into pieces.	8 cups	As above.

Extracting the Juice

1. Moisten a jelly bag. This may be flannel, unbleached muslin, two thicknesses of fine cheesecloth or a clean sugar bag.

2. Pour the hot, cooked fruit into the bag. Let drip into a large container. For a clear product do not squeeze the bag. For home use the bag may be squeezed by pressing with two wooden spoons. This gives good flavour and greater yield, although not as clear a jelly.

With fruits rich in pectin, as currants, crabapples, gooseberries and quince, two extractions of juice may be made. Measure the pulp. Add an equal amount of water. Cook slowly for 15 to 20 minutes. Extract the juice as at first.

3. Clarify the juice. Whether the first, second or combined extractions it is advisable to strain the juice through a moist jelly cloth, without squeezing. Let grape juice stand over night in a cold place before straining. This will reduce the number of crystals which may form in grape jelly.

Testing the Juice for Pectin

Either of the following tests may be used:

I. Alcohol Test

Use denatured or wood alcohol which may be purchased at any drug store. Eight ounces is usually sufficient for a season.

- Caution: Denatured alcohol is poisonous!
Do not let it come in contact with food!
Dispose of the juice after the test is made!
Wash utensils carefully after using!

TO MAKE THE TEST:

Pour one spoonful of extracted fruit juice into a small, flat dish. Measure an equal amount of denatured alcohol. Pour it gently into the dish. Do not stir. Let stand one to three minutes. Examine the results and interpret them by means of Table 8. Notice that the amount of sugar added to the juice varies directly with the amount of pectin in the juice.

Table 8 — Interpretation of Alcohol Test

Appearance	Pectin Content	Jellying Qualities of Juice	Amount of Sugar to Add to Each Cup of Juice
Firm, jelly-like mass with little or no liquid	High	Excellent	1 cup
Two or three clumps of jelly with noticeable liquid	Medium	Good	$\frac{3}{4}$ cup
A few small stringy lumps of jelly with much liquid	Low	Fair to Poor	$\frac{1}{2}$ cup

If the alcohol test indicates less than a fair pectin content boil the fruit juice down to half the original volume and repeat the test. Or to each cup of juice add 2 tablespoons of home-made or commercial pectin and repeat the test. This addition of pectin eliminates boiling down the juice.

II. Jelmeter Test

This test is made by means of an instrument called a jelmeter. Directions for using it are supplied with the instrument.

Converting the Juice into Jelly

Work with small quantities of juice at a time. Best results are obtained with not more than 4 to 6 cups of juice. Use a broad, flat-bottomed saucepan which fits the burner.

1. Measure the juice and add the proper quantity of sugar (as determined by the pectin test).
2. Cook the juice very rapidly. It should boil up to at least twice its volume. Slow cooking at this stage gives a dull, dark jelly of inferior texture and flavour.
3. Test the jelly to know when to remove it from the stove. This is the most difficult of all tests in jelly-making and one which greatly affects the finished product. Utmost care should be taken at this point. Any of three tests may be used. Sometimes a second test affords a check for the inexperienced person.
4. When the jelling point is reached, take the jelly from the stove. Let stand 30 seconds. Remove scum and pour into sterilized jelly glasses. Let stand a few minutes and remove any air bubbles which have collected on top.
5. Cover the jelly with a thin layer of melted paraffin. This may be done immediately or after the jelly has set
6. Examine the glasses next day for air holes in the paraffin. If this occurs cover with another thin coating of paraffin.

Spoon Test

This is the most reliable method but requires practice and experience in making correct observations. Lift a spoonful of the liquid and allow it to drip slowly from the edge of the spoon. As the liquid nears the jellying stage it will form in two distinct, straight-sided drops at the rounded part of the spoon edge. Watch carefully. Test repeatedly. When two drops tend to pull together, forming slanted edges, the jelly is done. Remove from heat at once.



Almost Done



Done

Thermometer Test

This test, although a very easy one, is not always accurate, but it serves as a guide in determining the jelly point. Use a candy thermometer. Boil the juice and sugar until the temperature reaches 220° F. approximately (eight to nine degrees above the boiling point of water).

Plate Test

Place a few drops of the liquid on a cold plate and allow it to stand in a cool place for a few minutes. When the liquid sets enough to wrinkle, the jelly is done. NOTE—This test requires from three to five minutes before the observations can be made. Hence it is necessary to remove the saucepan from the heat during this time to eliminate the danger of over-cooking.

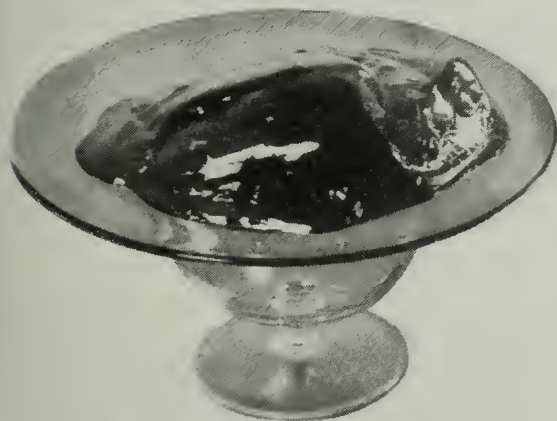
STANDARD FOR JELLY

Clear and sparkling.

Retains its shape when turned out on a plate, but quivers with a delicate tremor when the plate is shaken.

Tender—cuts easily but with distinct, clear-cut lines leaving sharp angles.

Natural colour and flavour.



Is Your Jelly Standard?

PROBLEMS RELATING TO JELLY-MAKING

Failure to Set

Fruit too ripe.

Juice low in pectin.

Pectin destroyed by prolonged cooking at a high temperature (often caused by boiling juice to concentrate it before adding sugar).

Juice lacking in acid.

Too much syrup for the amount of pectin.

Juice not cooked to finishing point (evaporation not complete).

Juice cooked beyond finishing point (pectin breaks down, forming a heavy syrup).

Cloudy, Foggy Jelly

Fruits immature. Green fruits contain starch which is insoluble in jelly.

Juice not clarified.

Juice cooked beyond finishing point, giving a sticky, gummy jelly.

Jelly allowed to cool before pouring—becomes lumpy and cloudy.

Jelly poured into glasses from too great a height—many air bubbles form and escape with difficulty.

Sugar Crystals

Fruits too low in acid.

Too much sugar used, or juice too concentrated before sugar is added.

Jelly allowed to stand for several days before paraffin cap is added—a crust of sugar crystals forms due to evaporation.

Weeping Jelly

(Clear liquid separates from jelly.)

Too great proportion of acid.

Tough Jelly

Too little sugar in proportion to the pectin and acid present.

Fermented Jelly

Jelly too soft and syrup ferments.

Liquid forming around edge in weeping jelly may ferment.

HOME-MADE PECTIN

Pectin for use in jelly-making may be prepared from lemons, oranges or apples. Lemon pectin is especially satisfactory, but good results are obtained by either apple or orange pectin. The pectin may be made in the jelly-making season and used at once, or it may be processed to keep for future use. Be sure to stir the pectin very thoroughly into the juice.

Lemon Pectin

Grate the outer yellow rind from 4 medium-sized lemons and discard. Remove seeds. Squeeze juice. Grind remainder as fine as possible in a food-chopper. Mix juice and pulp. Add 1 cup of water for each cup of juice and pulp. Simmer for 20 minutes in a covered saucepan. Squeeze as much of the cooked pulp as possible through a moist cotton cloth. If it is to be kept for future use, reheat to boiling. Pour into a sterilized jar and process 45 minutes in a hot water bath.

Orange Pectin

Cover skins of 6 oranges with water. Let stand over night. Then cook in boiling water for 5 minutes. Cut off the yellow part. Put the remainder through the grinder with 1 whole lemon from which the yellow part has been grated. To each cup pulp add 1 cup water. Simmer 20 minutes. Finish as for lemon pectin.

Apple Pectin

Clean slightly under-ripe apples. Do not peel or core. Slice. To 1 pound apples add 1 pint water. Bring to boil quickly. Simmer 20 minutes. Strain through a jelly bag. Press lightly with a wooden spoon. Take pulp from bag and add an equal quantity of water. Simmer again 20 minutes. Strain. Put the first two extractions together in a shallow kettle. Boil rapidly until liquid is concentrated to a quarter of the original amount. Put in sterilized jars and seal tightly.

Jams, Marmalades and Conserves

GENERAL DIRECTIONS FOR JAMS

Fruit used for jam should not be over-ripe. It is well to include some under-ripe fruit because of the extra pectin it contains. To prepare the fruit, wash and cut finely or mash. Less juicy fruits may have some water added before cooking. Fruits low in acid are improved by the addition of tart fruit or lemon juice. Heat slowly to extract the juice without burning. Stir frequently. When the fruit is thoroughly cooked measure the cooked fruit. Add sugar according to the pectin content of the fruit. Refer to Table 6, page 26, "Classification of Fruits".

For fruits in Group 1 use $\frac{3}{4}$ cup to 1 cup sugar per cup of cooked fruit.

For fruits in Groups 2 and 5 use $\frac{1}{2}$ cup to $\frac{2}{3}$ cup sugar per cup of cooked fruit.

Fruits in Groups 3 and 4 will not make jam without additional pectin.

It is safer to use too little sugar than too much.

Stir to dissolve the sugar. Cook quickly to retain colour and flavour.

Remove from the stove when the mixture will remain heaped up on the lifted spoon or when the jelly test is observed. Pour into sterilized glasses and when cold cover with paraffin.

MARMALADES

Marmalades are usually made from pulpy fruits which contain both pectin and acid. They are prepared in the same way as jam except that the fruit is not mashed but is cut into small pieces or thin slices. A good marmalade is a jelly-like mass with the pieces of fruit suspended in it.

CONSERVES

A conserve is a jam made of a combination of two or more fruits. If large fruit is used it should be sliced or diced, but small fruit may be left whole. Nuts and raisins or both may be added to any mixture of fruit in the making of conserves. If nuts are used, they should be added to the conserve as it is removed from the fire.

RECIPES

The following recipes give proportions which have been found satisfactory. *In most of the recipes the proportions stated are for 1 cup of fruit. These may be increased as desired, always keeping the same proportions.* It is advisable to work with small quantities, not more than 4 or 5 cups of fruit.

Blueberry Jam

1 cup blueberries, mashed
 $\frac{1}{2}$ cup water
Few grains of salt

1 tablespoon lemon juice
 $\frac{1}{2}$ cup sugar to 1 cup
cooked fruit

Cook blueberries with water, lemon juice and salt until soft. Measure cooked fruit. Add sugar. Boil to the jelling point.

Red Currant Jam

1 cup currants 1 cup water
 $\frac{3}{4}$ cup sugar to 1 cup cooked fruit

Add water to currants and cook slowly. Measure cooked fruit. Add sugar. Boil to the jelling point.

Gooseberry Jam

1 cup gooseberries 1 cup water
 $\frac{3}{4}$ cup sugar to 1 cup cooked fruit

Mash or grind the berries. Add the water and cook until soft. Measure the cooked fruit. Add sugar. Boil rapidly to the jelling point.

Grape Jam

Slip skins from pulp. Measure pulp. Add water ($\frac{1}{4}$ cup to 1 cup pulp). Cook until soft. Put through a sieve. The skins may be put through a food chopper. Add skins to pulp. Measure mixture. Add sugar (1 cup to 1 cup mixture). Boil to the jelling point.

Spiced Grape Jam

Proceed as for Grape Jam adding to each cup of mixture approximately $\frac{1}{4}$ teaspoon cinnamon, $\frac{1}{8}$ teaspoon cloves and $\frac{1}{8}$ teaspoon allspice, ground.

Grape and Apple Jam

$\frac{3}{4}$ cup apples, cut up $\frac{3}{4}$ cup water
 $\frac{3}{4}$ cup grape pulp $\frac{3}{4}$ cup sugar to 1 cup fruit mixture

Cook the apples with the water until soft. Add the grape pulp. Measure the mixture. Add sugar. Boil to the jelling point.

Peach Jam

1 cup peaches, cubed 1 $\frac{1}{2}$ tablespoons lemon juice
 $\frac{1}{2}$ cup sugar

Cook peaches and lemon juice until soft. Measure the cooked mixture. Add sugar and boil to the jelling point.

Pineapple Jam with Liquid Pectin

1 cup shredded pineapple $\frac{3}{4}$ cup sugar to 1 cup cooked fruit
 $\frac{1}{2}$ tablespoon lemon juice 2 tablespoons liquid pectin

Add lemon juice to pineapple. Boil 10 minutes. Measure cooked fruit. Add sugar and boil 5 minutes. Add liquid pectin. Remove from fire and stir thoroughly.

Plum Jam (Lombard)

1 cup plums, pitted and cut up 1 tablespoon lemon juice
 $\frac{1}{2}$ cup water 1 cup sugar to 1 cup cooked fruit

Cook the plums with the water and lemon juice until soft. Measure the cooked fruit. Add the sugar. Boil to the jelling point.

For sweeter varieties of plums use 2 tablespoons lemon juice.

Raspberry Jam

1 cup mashed berries 2 tablespoons red currant juice, or
 $\frac{7}{8}$ cup sugar to 1 cup 1 tablespoon lemon juice
cooked fruit

Add lemon juice to berries and heat slowly. Measure the cooked fruit. Add sugar. Boil to the jelling point.

Rhubarb Jam

1 cup rhubarb $\frac{1}{2}$ cup sugar to 1 cup
 $\frac{1}{4}$ cup water cooked fruit

Cut up rhubarb. Add water. Cook 5 minutes. Measure the cooked fruit. Add sugar. Boil to the jelling point.

Rhubarb and Pineapple Jam

2 cups rhubarb
1 cup water

1 cup pineapple
 $\frac{1}{2}$ cup sugar to 1 cup cooked fruit

Cook fruit and water together until soft. Measure cooked fruit. Add sugar. Boil to the jelling point.

Rhubarb and Strawberry Jam

$\frac{1}{4}$ cup cut rhubarb
 $\frac{1}{4}$ cup water

1 cup crushed strawberries
 $\frac{2}{3}$ cup sugar

Cook rhubarb with water until soft. Add strawberries. Cook very slowly until soft. Add sugar. Boil to the jelling point.

Whole Strawberry Jam

1 cup whole strawberries

$\frac{2}{3}$ to $\frac{3}{4}$ cup sugar

Juice from $\frac{1}{4}$ cup gooseberries

Add gooseberry juice to strawberries. Simmer until soft. Add sugar. Boil to the jelling point.

Thimbleberry Jam

1 cup mashed berries
 $\frac{1}{4}$ cup water

1 tablespoon lemon pectin
 $\frac{1}{2}$ tablespoon lemon juice

$\frac{3}{4}$ cup sugar

Add water and lemon juice to berries. Cook slowly until soft. Add lemon pectin and sugar. Mix thoroughly and boil to the jelling point.

Orange, Lemon and Grapefruit Marmalade

2 oranges, large
2 lemons, large

6 pints water
9 cups sugar

1 grapefruit

Peel grapefruit. Remove white pulp from rind. Discard white pulp and cut rind into long fine pieces. Slice fruit pulp.

Oranges and lemons may be prepared as grapefruit. Or, if the skin is not too thick and a large amount of solid particles is desired, cut the oranges and lemons into quarters or eighths lengthwise and slice these across very fine. If the lemons are not very juicy add the juice of 1 extra lemon.

To the fruit pulp and rind add 6 pints water. Let stand several hours or overnight. Boil for one-half hour. Add 9 cups sugar. Boil until the jelly test is observed, that is, until the liquid "sheets" when dropped from a spoon.

Apricot and Pineapple Marmalade

1 pound dried apricots
2 cups shredded pineapple

2 to $2\frac{1}{2}$ pounds sugar
 $1\frac{1}{2}$ pints water

Soak apricots in water overnight. Chop them. Combine all ingredients. Cook until the jelly test is observed. Seal in sterilized jars.

Damson Plum Conserve

1 quart damson plums
1 orange

Juice of $\frac{1}{3}$ lemon
 $\frac{1}{4}$ cup blanched almonds

$1\frac{1}{2}$ cups sugar

Remove the pits from the plums. Add a small amount of water if necessary, and cook until the skins are soft. Add the chopped orange pulp and sugar. Cook until the mixture is thick and clear. Add the lemon juice at the end of the cooking period. Remove from the fire. Add blanched, slivered almonds. Seal in sterilized jars.

Pickles



Pickling of fruits and vegetables means their preservation in brine or vinegar with or without fermentation. In making pickles, the micro-organisms which cause spoilage are controlled by making conditions so unfavourable that these organisms cannot grow. Pickles are made either by the quick process or the long (fermentation) process.

INGREDIENTS USED FOR PICKLES

Fruits or Vegetables

Select fresh products of good quality, free from spots or blemishes. Green or slightly under-ripe products give firmer, crisper pickles. Cucumbers should not be allowed to stand more than 24 hours after picking.

Vinegar

Vinegar is used in pickle-making to modify the taste and flavour, to aid in securing the desired type of fermentation and to act as a preservative. Vinegar should test from 4% to 6% acetic acid and be free from sediment. According to regulations, vinegar on the market must contain not less than 3½% and not more than 10½% acetic acid. The strength of vinegar is difficult to determine in the home. Vinegar for use in pickle-making should be diluted according to the individual taste. It was found that vinegar testing 4.4% acetic acid required to be diluted in the proportion of 2 parts vinegar to 1 part water for the recipes given in this section.

Spices

These should be used in moderation. Fresh spices should be purchased each year. Spices may be tied in a cheesecloth bag and cooked with the vinegar long enough to give a spicy flavour and then removed; or the spice may be added directly to the vinegar.

Grape Leaves

These are sometimes used to improve the colour of the pickles, but they are of doubtful value. However, they make a good covering for pickles in an open crock.

Alum

Because alum is an astringent its use is not recommended, although it tends to make the pickles firmer. The desired firmness may be obtained by controlling the salt and acid content. Never use more than one teaspoon of powdered alum to 4 quarts of brine.

Salt

Use only pure salt. Common cooking or dairy salt is preferred to fine table salt. Salt which has a substance added to prevent caking should not be used.

Water

The water used should be as pure as possible and freed from organic matter by straining it. Soft water is recommended because the hard water contains mineral salts which prevent proper acid formation with pickles made by the fermentation process. If the water that is to be used for brine contains much lime, add to it a small amount of vinegar (1 tablespoon of vinegar to 1 quart of water).

Table 9 — Brines Used for Pickling

Strength	Amount of Salt to 1 Quart of Water	Use
5% Weak	$\frac{1}{4}$ cup	Cucumber pickles Bread and butter pickles Mixed vegetables Chunk pickles
10% Medium.....	$\frac{1}{3}$ cup	Sour mustard pickles Sweet mustard pickles Watermelon rind
15% Medium to strong.....	$\frac{1}{3}$ to $\frac{1}{2}$ cup	Sweet gherkins Sour gherkins
20% Strong.....	$\frac{3}{4}$ cup	Onions

QUICK PROCESS METHOD

This method is usually adopted for pickled fruits, relishes and many vegetable pickles. It is a less exacting method than the long process and is preferred by the average housewife.

Put the vegetables in a crock and cover with a weak brine. Use a weighted plate to keep them under the brine. Leave them in the brine for 24 hours. If left longer they may become soft and spoil, especially in warm weather.

Drain off the brine and rinse in clear, cold water. The vegetables are now ready for pickling and are treated according to the directions given for the kind of pickle to be made.

LONG PROCESS METHOD

In the long process the vegetables are cured by placing them for some time in brine of sufficient strength to prevent the growth of spoilage bacteria, while permitting fermentation due to the growth of lactic acid bacteria. Due to osmotic action the juice is drawn from the vegetables into the brine and the brine is taken up by the vegetables. At first the flow of juice outward is more rapid than the inflow of brine, which causes a slight shrivelling of the vegetables. Later the inflow of brine is sufficiently rapid to make the vegetables firm and plump. At the same time they become crisp and the flavour is changed. This long process method when used for vegetables, particularly cucumbers, gives a pickle of finer flavour, crisper texture and more attractive appearance than does the short process method.

To Cure Cucumbers

For a four-gallon crock use—

10 to 12 pounds cucumbers ($\frac{1}{4}$ bushel).

9 quarts brine (9 quarts soft water to $3\frac{1}{4}$ cups cooking salt).

Prepare the cucumbers and put into the crock. Cover with a strong brine made with soft water. If hard water is used add 1 tablespoon vinegar to each quart of water. If it is desired to hasten fermentation add 1 teaspoon sugar to each quart of brine. Cover the cucumbers with a weighted lid so that they are well under the brine. Tie over the top of the crock a thin, clean cloth. Set the crock in a warm place (80° - 85° F.).

The brine should not fall below its original strength. To prevent this, salt must be added from time to time since the brine is steadily diluted by the juices it draws from the cucumbers.

At the end of the first day, place salt on the cover (1 pound salt for 10 pounds of cucumbers). From this position the salt will gradually dissolve. At the end of each week for five weeks, place on the cover $\frac{1}{4}$ pound salt for 10 pounds cucumbers. This amount gradually increases the strength of the brine until at the end of five or six weeks the strength will have reached 15%.

Every few days remove the scum which forms, being careful not to mix it with the brine.

The cucumbers, at the end of fermentation, should be clear and translucent, dark olive green in colour, free from whitish spots, firm and crisp in texture and should have a good, fermented flavour.

To Freshen Cucumbers Taken from the Brine

Drain off brine. Cover cucumbers with warm water (100° - 120° F.). Let stand 6 to 12 hours. Stir occasionally. Repeat two or three times according to the degree of saltiness desired. Drain. The cucumbers are now ready for the pickling solution.

To Cure Other Vegetables

Prepare vegetables as required. Proceed as for cucumbers.

To Freshen Cauliflower, Onions or Snap Beans

Cover vegetables with water. Simmer for about 20 minutes. Allow vegetables to cool in the water. Drain and rinse in fresh water. The vegetables are now ready for the pickling solution.

Pickling Solution

Two quarts of pickles require 1 quart of pickling solution.

Pickling Solution for Sour Pickles

1 quart cider vinegar

$\frac{1}{2}$ cup sugar

$\frac{1}{2}$ tablespoon celery seed

$\frac{1}{2}$ tablespoon whole cloves

$\frac{1}{2}$ tablespoon mustard seed

$\frac{1}{2}$ tablespoon peppercorns

Mix vinegar and sugar. Add spices tied loosely in a piece of cheesecloth. Heat to boiling point and boil five minutes.

Pickling Solution for Sweet Pickles

1 quart vinegar

2 cups sugar

1 teaspoon allspice (whole)

1 tablespoon cinnamon (whole)

1 tablespoon cloves (whole)

1 tablespoon white mustard seed

Proceed as for sour pickles.

PICKLING PROBLEMS

Shrivelling

- Vinegar too hot or too strong.
- Brine too strong.
- Too much sugar.
- Stale products.
- Too much alum, if used to preserve crispness.

Change of Colour

- Bright green—wrong vinegar or use of copper utensils.
- Blackening—excess of iron in the water.
- White blotches—not cured well in brine.
- Bleached—vinegar too strong.

Softening

- Vinegar too weak to prevent growth of micro-organisms. If boiled too long it loses its strength.
- Brine too weak.
- Exposure of pickles above brine or vinegar.
- Cooking too long.
- Stale products.
- Storage in too warm a place.

Slipperiness

- Brine too weak to prevent bacterial action.
- Pickles exposed above brine or vinegar.

Hollowness

- Stale products.
- Growth conditions—hot, dry season.

RECIPES

Pickled Beets

Cook beets till tender. Remove skins. Pack into sterilized jars. Mix $1\frac{1}{2}$ cups vinegar, $\frac{1}{2}$ cup water, $\frac{3}{4}$ cup sugar and 1 tablespoon salt. Bring to a boil and pour over beets. Seal tightly.

Spiced Beets

Cook young beets until tender. Remove skins. Pack in sterilized jars. Cover with boiling spiced vinegar. Process in hot water bath 15 minutes.

Spiced Vinegar—

1 cup vinegar	$\frac{1}{4}$ teaspoon allspice
$\frac{1}{2}$ cup sugar	$\frac{1}{4}$ tablespoon white mustard
$\frac{1}{4}$ tablespoon cinnamon	$\frac{1}{4}$ teaspoon cloves
$\frac{1}{2}$ teaspoon salt	

Sweet Gherkins

1 pint gherkins	1 tablespoon mustard seed
1 cup vinegar	$\frac{1}{4}$ tablespoon stick cinnamon
$\frac{1}{2}$ tablespoon sugar	$\frac{1}{4}$ tablespoon whole cloves
$\frac{1}{8}$ tablespoon celery seed	$\frac{1}{4}$ tablespoon allspice

Let gherkins stand in medium brine over night. Drain. Wash in cold water. Drain. Tie the spices in a bag and add to the vinegar and sugar. Bring to boiling point and pour over the gherkins. For this amount of pickles, stir in 1 tablespoon of sugar each morning until the desired sweetness is obtained (about 8 days).

Bread and Butter Pickles

2 cups thinly sliced, mixed vegetables (cucumbers, onions and green peppers)	1 cup white sugar
1 cup vinegar	$\frac{1}{8}$ teaspoon turmeric
	$\frac{1}{2}$ tablespoon mustard

Let the vegetables stand in weak brine over night. Drain. Heat vinegar, sugar, turmeric and mustard. Add vegetables and bring slowly to the boiling point. Remove from stove and fill sterilized jars.

Mustard Pickles

2 quarts cucumbers	3 green peppers
2 quarts onions	3 red peppers
1 cauliflower	2 heads celery

Chop and cover with hot brine ($\frac{1}{2}$ cup salt to 1 quart water). Let stand overnight. Drain. Rinse with cold water. Add sweet mustard sauce. Let pickles come to a boil. Fill sterilized jars and seal.

Sweet Mustard Sauce

1 $\frac{1}{2}$ cups flour	$\frac{1}{2}$ ounce turmeric
$\frac{1}{4}$ pound mustard	$\frac{1}{2}$ gallon vinegar
8 cups granulated sugar	2 ounces mustard seed

Salt to taste

Mix the first four ingredients thoroughly. Make into a thin paste with part of the cold vinegar. Add to the hot vinegar and mustard seed. Cook, stirring constantly until it boils and thickens.

Mixed Vegetable Mustard Pickle

Use vegetables in any combination to make approximately 1 quart, such as—

$\frac{1}{2}$ cup onions sliced or very small	$\frac{1}{2}$ cup tiny cucumbers
$\frac{1}{2}$ cup corn, cut from the cob	$\frac{1}{2}$ cup large cucumbers, peeled and sliced
$\frac{1}{2}$ cup yellow beans, cut up	$\frac{1}{4}$ cup chopped green peppers
$\frac{1}{2}$ cup green beans, cut up	$\frac{1}{4}$ cup chopped red peppers
$\frac{1}{2}$ cup cauliflower flowerets, quartered	$\frac{1}{4}$ cup carrots, diced

Cover with weak brine and let stand overnight. Drain. Soak one hour in clear water. Drain. Add 1 cup water and 1 cup vinegar and let stand 15 minutes. Cook until vegetables are tender. Drain. Add sweet mustard sauce, using one-eighth of the recipe given under mustard pickles or sour mustard sauce. Let the pickles come to a boil. Fill sterilized jars and seal.

Sour Mustard Sauce

1 tablespoon flour (pastry)	$\frac{1}{8}$ tablespoon turmeric
$\frac{3}{4}$ tablespoon mustard	1 cup vinegar
$\frac{1}{4}$ cup brown sugar	$\frac{1}{8}$ tablespoon celery seed

Salt to taste

Proceed as for Sweet Mustard Sauce.

Mustard Bean Pickle

1 quart beans, cut in lengths or in halves	$\frac{2}{3}$ tablespoon celery seed
1 pint vinegar	$\frac{2}{3}$ tablespoon turmeric
2 cups sugar	$\frac{1}{3}$ cup mustard
	$\frac{1}{3}$ cup flour

Cook beans until tender. Drain. Make mustard sauce. Cover beans and bring to a boil. Pack in sterilized jars and seal.

Pickled Silver Skin Onions

Soak 1 cup white onions (peeled) in strong brine for 24 hours. Soak in fresh water 1 hour and drain.

Mix the following—

$\frac{1}{2}$ cup white vinegar	$\frac{1}{2}$ tablespoon allspice
2 tablespoons sugar	$\frac{1}{2}$ tablespoon white mustard seed
2 peppercorns	

Boil one minute. Pack onions into clean, sterilized jars. Cover with boiling syrup and seal.

Watermelon Rind Pickle

1 $\frac{1}{2}$ cups watermelon rind (cut 2" x $\frac{1}{2}$ ")	1 cup sugar
$\frac{1}{2}$ cup vinegar	$\frac{1}{4}$ teaspoon whole allspice
$\frac{1}{2}$ cup water	$\frac{1}{4}$ teaspoon stick cinnamon
$\frac{1}{4}$ lemon, sliced thin	$\frac{1}{4}$ teaspoon whole cloves

Soak watermelon rind in medium brine overnight. Drain and wash with fresh water. Drain. Boil in clear water until tender. Mix other ingredients and boil 5 minutes. Add rind and boil until clear. Pack into sterilized jars.

Dill Pickles No. 1

Wash cucumbers and wipe well. Pack into jars. To 1 quart jar add—

4 teaspoons salt	1 clove garlic
1 small, hot, red pepper	Dill and savoury

Fill jar with mixture of vinegar and water in the proportion of 1 quart white vinegar to 2 quarts water. Seal tightly. Ready to use in 6 weeks.

Dill Pickles No. 2

2 quarts medium-sized cucumbers	2 tablespoons coarse salt
6 tablespoons sugar	2 sprigs fresh dill or 1 $\frac{1}{2}$
1 quart of diluted vinegar or enough	tablespoons dillseed
to cover	

Soak cucumbers in cold water overnight. Drain. Mix sugar, salt, dill and vinegar and pour over cucumbers. Seal and store.

Catsups and Relishes

Grape Catsup (2 Quarts)

6 cups grapes (crushed)	1 teaspoon salt
1 $\frac{1}{2}$ cups vinegar	1 teaspoon ground cloves
3 $\frac{1}{2}$ cups granulated sugar	1 teaspoon ground cinnamon
1 teaspoon ground allspice	

Cook grapes until soft and rub through a sieve, removing the seeds. Add other ingredients and boil until of the desired consistency. Fill sterilized jars and seal.

Tomato Catsup (2 Quarts)

16 quarts tomatoes, washed and	4 cups chopped onions
cut up	4 cups chopped celery
4 cups chopped red peppers	8 bay leaves

5 Cook until soft. If tomatoes are watery, time and fuel are saved by removing some of the liquid and using it for tomato juice. Remove 4 quarts of juice, boil separately, pour into sterilized jars and seal.

Put the remaining pulp through a sieve. Add the following, tying the spices in a bag—

2 cups granulated sugar	2 teaspoons mace
4 tablespoons salt	2 teaspoons paprika
2 $\frac{2}{3}$ cups vinegar	2 tablespoons peppercorns
2 tablespoons cloves	

Cook to the desired consistency. Fill sterilized jars and seal.

Chili Sauce (2 Quarts)

Cook until soft—

4 quarts tomatoes (cut up)	1 cup chopped green pepper
1 cup chopped red pepper	1 cup chopped onion
1 cup chopped celery	

Strain off 3 cups tomato juice. Add to the pulp the following—

1 to 2 cups brown sugar	$\frac{1}{2}$ teaspoon ground allspice
1 cup vinegar	$\frac{1}{2}$ teaspoon ground cinnamon
2 tablespoons salt	$\frac{1}{2}$ teaspoon ground cloves
$\frac{1}{4}$ teaspoon ginger	

Boil to the desired consistency. Fill sterilized jars and seal.

Chow Chow (2 Quarts)

2 cups chopped cucumber	2 cups chopped onion
2 cups chopped cauliflower	1 cup chopped green pepper

Let soak in strong brine overnight. Drain and chop.

Make a sauce from the following—

2 cups vinegar	1 tablespoonful mustard seed
2 cups granulated sugar	$\frac{1}{2}$ tablespoon celery seed
3 tablespoons flour	1 teaspoon turmeric

5 tablespoons mustard

Add the pickle. Simmer until tender. Put into sterilized jars and seal.

Corn Relish No. 1 (2 Quarts)

4 cups corn (kernels cut from cob)	$\frac{1}{3}$ teaspoon turmeric
$1\frac{1}{3}$ cups chopped ripe cucumber	$\frac{1}{3}$ teaspoon celery seed
$1\frac{1}{3}$ cups quartered tomatoes	$1\frac{1}{3}$ cups white sugar
$\frac{2}{3}$ cup chopped onions	$2\frac{2}{3}$ tablespoons salt
$\frac{1}{3}$ cup chopped red and green pepper (combined)	$1\frac{2}{3}$ cups vinegar

Combine and bring to a boil. Cook until the corn is tender. Thicken with $1\frac{1}{3}$ tablespoon flour and $1\frac{1}{3}$ tablespoons mustard. Cook 5 minutes and remove from the stove. Pour into sterilized jars and seal.

Corn Relish No. 2 (2 Quarts)

4 cups corn (cut from cob)	$\frac{1}{2}$ cup chopped green peppers
2 tablespoons chopped onions	2 cups finely cut cabbage
1 cup chopped celery	$\frac{1}{2}$ tablespoon turmeric
$\frac{3}{4}$ cup sugar	$\frac{1}{2}$ tablespoon celery seed
1 tablespoon flour	2 cups vinegar

$\frac{1}{2}$ tablespoon mustard

Cook vegetables in salted water until tender. Mix dry ingredients with a little of the cold vinegar. Heat the remainder of the vinegar and stir in the paste. Cook until thick. Add the cooked vegetables and boil five minutes. Fill sterilized jars and seal.

Ripe Cucumber Relish (2 Quarts)

Peel, remove seeds and chop ripe cucumbers to make 4 cups. Add 4 tablespoons chopped onions. Sprinkle with 2 tablespoons salt and cover with water. Let stand one hour and drain.

1 cup vinegar	$\frac{1}{8}$ teaspoon ground cloves
$\frac{1}{2}$ teaspoon mustard seed	$\frac{1}{8}$ teaspoon ground cinnamon
$\frac{1}{2}$ teaspoon ground mustard	$\frac{1}{2}$ tablespoon turmeric

Boil the vinegar with the spices tied in a bag. Add vegetables and cook slowly until tender. Pack into sterilized jars and seal.

Dixie Relish (2 Quarts)

1 cup chopped red peppers	2 tablespoons mustard seed
1 cup chopped green peppers	1 tablespoon celery seed
1 cup chopped onion	$\frac{1}{4}$ cup sugar
1 cup chopped cabbage	2 cups vinegar

$2\frac{1}{2}$ tablespoons salt

Soak peppers in medium brine for 24 hours. Freshen in cold water one to two hours. Drain and chop. Mix chopped vegetables and let stand in crock overnight. Pack into jars. Cover with vinegar and seasonings. Partially seal. Process in a hot water bath for ten minutes. Remove and seal.

Fruit Relish (2 Quarts)

2 quarts tomatoes peeled and cut up	1 teaspoon salt
1 cup chopped onion	2 cups vinegar
2 cups chopped celery	$\frac{1}{2}$ tablespoon allspice
2 cups diced peaches	$\frac{1}{2}$ tablespoon cloves
2 cups diced pears	4 cups white sugar

Tie spices in a bag. Add to other ingredients and cook two hours or until quite thick. Add sugar and boil 30 minutes. Pour into sterilized jars and seal.

Pepper Relish (2 Quarts)

1 cup chopped onions	1 $\frac{1}{3}$ cups chopped red peppers
4 cups chopped cabbage	2 $\frac{2}{3}$ cups chopped green peppers

Sprinkle with 4 tablespoons salt. Let stand overnight. Drain.

Add—

4 tablespoons mustard seed	2 cups sugar
$\frac{1}{2}$ teaspoon celery seed	2 cups vinegar (white wine)

Cook until it just comes to a boil. Pour into sterilized jars and seal.

Beet Relish (2 Quarts)

8 cups chopped, cooked beets	1 cup horseradish, grated
1 $\frac{1}{3}$ cups chopped red peppers	$\frac{1}{2}$ cup sugar
1 cup chopped onions	1 $\frac{1}{3}$ tablespoons salt
4 cups vinegar	

Cook beets until tender. Remove skins and chop. Add onions and peppers. Combine all ingredients and cook until mixture is clear. Pour the hot mixture into sterilized jars and seal.

Celery Relish No. 1 (2 Quarts)

5 cups tomatoes, peeled and cut up	$\frac{1}{2}$ cup chopped green peppers
8 tablespoons chopped onions	2 cups brown sugar
8 cups chopped celery	2 tablespoons salt
6 cups vinegar	

Mix ingredients. Boil until the consistency of sauce (about one hour).

Celery Relish No. 2 (2 Quarts)

2 quarts chopped celery	2 cups vinegar
$\frac{1}{2}$ cup chopped red peppers	$\frac{1}{2}$ cup sugar
$\frac{1}{2}$ cup chopped green peppers	1 teaspoon salt
$\frac{1}{2}$ cup chopped white onions	1 teaspoon mustard

Use large stalks of celery. Chop celery and onion. Cook separately in salted water until tender (2 teaspoons salt per quart of water). Drain. Add chopped peppers and other ingredients. Cook until tender. Fill sterilized jars and seal.

Rhubarb Relish (2 Quarts)

1 quart rhubarb, cut finely	1 teaspoon cloves
1 quart chopped onions	1 teaspoon allspice
4 cups brown sugar	1 teaspoon cinnamon
2 cups vinegar	1 teaspoon red pepper
1 teaspoon salt	

Boil together until thick. Fill sterilized jars and seal.

Raw Cranberry and Apple Relish

1 cup cranberries, chopped	1 tablespoon lemon juice
1 cup tart apples	1 cup sugar

Mix and let stand two to three hours.

Raw Cranberry Relish

1 pound cranberries	2 large oranges
1 $\frac{1}{2}$ cups granulated sugar	

Wash cranberries and put through the chopper. Grate rind of oranges. Discard white membrane and seeds. Put remainder through the chopper. Combine all ingredients. Let stand 24 hours before using. (This relish will keep two to three weeks in a cold place.)

Spiced Fruit

Spiced Sour Cherries

2 cups sour cherries
1½ cups sugar

Vinegar

1 tablespoon ground cinnamon
¼ tablespoon ground cloves

Sprinkle sugar over pitted cherries and let stand overnight. In the morning stir until the sugar is dissolved, heating slightly if necessary. Drain syrup from cherries. Boil syrup and spices to ¾ of original volume. Fill sterilized jars with cherries. Cover with hot syrup. Add 2 tablespoons vinegar to each pint. Seal.

Spiced Sweet Cherries

(Mock Olives)

1 cup vinegar
1 cup cold water
3 tablespoons brown sugar

1 teaspoon salt
½ ounce stick cinnamon
1 tablespoon whole cloves

Tie spices in a bag and add to other ingredients. Boil 5 minutes. Cool and remove spices. Wash cherries and pack unpitted in sterilized jars. Pour syrup over cherries and seal.

Spiced Currants

1 cup cooked currant pulp
1 tablespoon vinegar

⅔ cup sugar

¼ teaspoon cinnamon
⅛ teaspoon cloves

Mix all ingredients thoroughly and cook to the jelling point. Fill sterilized jars and seal.

Spiced Green Gooseberry Jam

1 cup gooseberries (mashed)
¾ cup water
1 tablespoon vinegar

1 cup sugar
¼ teaspoon cinnamon
⅛ teaspoon cloves

Cook gooseberries slowly with water and vinegar until soft. Add sugar and spices. Mix thoroughly and cook to the jelling point. Fill sterilized jars and seal.

Pickled Peaches, Pears or Crabapples

1 quart fruit
1 cup vinegar
⅔ cup water

2⅔ cups sugar
⅔ ounce stick cinnamon
⅛ ounce whole cloves

Boil sugar, vinegar and spices 10 minutes. Wash fruit. Rub fur off peaches. Put into syrup and cook until soft. Fill sterilized jars and seal.

Sandwich Spread (2 Quarts)

Cook over direct heat in top part of a double boiler—

3 cups chopped, sweet, green peppers
3 cups chopped, sweet, red peppers
2 cups vinegar

2 cups granulated sugar
3 tablespoons mustard
3 teaspoons salt

Place over boiling water and add—

⅔ cup milk
⅔ pound grated cheese

8 eggs (well beaten)

1⅓ cups butter
3 tablespoons cornstarch

Cook three or four minutes until thick. Put in sterilized small jars and seal.

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THE WEEDS OF ONTARIO

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by

J. EATON HOWITT, M.S.A., AND JOHN D. MACLEOD

INTRODUCTION

The control measures recommended in this bulletin for the most troublesome weeds in Ontario have been proved effective either by experiments conducted by the Ontario Agricultural College or by the experience of practical farmers under ordinary farm conditions. In a bulletin of this kind, it is obviously impossible to deal with all the weeds that occur in the Province and such has not been attempted. An attempt, however, has been made to describe and suggest methods of control for all the weeds that are a menace to agriculture in Ontario. There are many roadside, waste place, lawn and garden weeds not described in this publication. Those interested in any of these can have them identified and secure information about them by sending carefully packed specimens to the Botanical Department, Ontario Agricultural College, Guelph, together with their name and address.

CHEMICAL WEED KILLERS

Many chemical weed killers are now on the market. Some of them are very effective, and they can often be used to great advantage to kill small patches of such pernicious perennial weeds as Field Bindweed, Perennial Sow Thistle and Leafy Spurge. Their cost, however, usually makes their use on large areas prohibitive. They can also be used to kill many roadside and waste place weeds economically. They will, however, never take the place on the farm of good cultivation and crop rotation in the fight against weeds. The use of chemical weed killers is still largely in the experimental stage. New chemical weed killers are being introduced each year and new recommendations made as to how to use them. Up-to-date information regarding the use of chemical weed killers can be obtained by writing to the Crops, Seeds & Weeds Branch, Department of Agriculture, Toronto, Ontario.

WHAT IS A WEED?

There are several definitions of a weed, viz.: "A plant out of place"; "Any injurious, troublesome or unsightly plant that is at the same time useless, or comparatively so"; "A plant which interferes with the growth of the crop to which the field is temporarily devoted."

INJURIOUS EFFECTS OF WEEDS

1. They absorb soil moisture and thus lessen the supply of water available to the crop plants. "An average Mustard plant pumps from the soil about fourteen ounces, or seven-tenths of a pint, per day."

2. They use up the plant food in the soil, and thus rob the crop plants. Furthermore, they often mature their seeds before the crop plants, and during the time they are ripening their seeds draw heavily upon the plant food in the soil, and thus leave little available for the crop plants when they require it to mature their seeds.

3. They shade, crowd and choke out useful plants. Weeds frequently grow more vigorously than the crop plants, and thus often stand above them, preventing the light and air required for healthy growth from reaching them.

4. Weeds are a constant source of expense. They increase the cost of every operation, in the preparation of the land, and in the seeding, cultivating, harvesting and marketing of the crop.

5. They may interfere with the regular rotation of crops. It is sometimes necessary, on account of some particular weed, to drop some crop from the rotation entirely.

6. Some weeds, such as Water Hemlock and Horsetail, are poisonous to stock. Quite frequently reports are received of stock being poisoned by eating such weeds.

7. Milk is often tainted by the cows eating such weeds as Wild Garlic and Stinkweed.

8. The market value of seed grain, clover and grass seeds is much decreased by the presence of weed seeds in any quantity.

9. Weeds often harbour or favour the development of injurious insects and fungous diseases.

10. Weeds are unsightly, and their presence detracts very materially from the value of a farm. No man cares to buy a weedy place if he can secure a clean one.

INTRODUCTION AND SPREAD OF WEEDS

Most of the injurious weeds found in this Province have come directly or indirectly from other countries. They are brought in and conveyed from field to field and farm to farm in various ways:

1. *By the wind.* Seeds which are carried by the wind usually have tufts of fine hair attached to them. Such are the seeds of Perennial Sow Thistle, Canada Thistle, Orange Hawkweed and Prickly Lettuce.

Some weeds are rolled along the ground by the wind. To this class belong Russian Thistle, Tumbling Weed and Old Witch Grass. When these weeds ripen they break off close to the ground, and being light they are easily carried by the wind, especially on open fields, and the seeds drop out as the weeds roll from place to place.

Seeds which become sticky when wet often adhere to leaves and are taken wherever the leaves are carried by the wind. This is true of Ribgrass or Buckhorn.

2. *By water.* Some seeds are distributed by water. Rivers, creeks and spring freshets carry weed seeds from one district to another. The Docks and Ragweed are often distributed in this way.

3. *By birds and animals.* Seeds are distributed by animals in a variety of ways. Approximately 10 per cent of all flowering plants possess seeds which are dispersed by means of barbed or cleaved processes. By means of these the seeds cling to the feathers of birds and the hairy coats of animals and are carried from place to place. To this class belong Burdock, Devil's Pitch Fork, Hound's Tongue, Stickseed and many others.

Weed seeds often pass through the stomach of animals without being digested, and during their passage they are conveyed hither and thither by the animals and are finally deposited to grow and reproduce their kind. Every farmer knows the truth of this statement as regards cattle, horses and swine. Sheep, it is said, have the power to digest and prevent the germination of weed seeds.

4. *By man.* Man himself, however, has most to do with the spread of troublesome weed seeds, chiefly through the agency of impure seeds, railroads, farmyard manure, feed-stuffs and implements such as the separator. The sowing of impure seed can be held chiefly responsible for the spread of many bad weeds throughout the Province.

Either through carelessness or ignorance, far too much impure seed is sown every year. Such seed is dear at any price. Pure seed is the farmer's right by law, and he should insist upon having it.

Many weeds are carried from one province or country to another in the fodder and litter used by animals in transit on railways and in grain carried by rail. More or less of the grain, litter and fodder are scattered at places along the track and at stations where grain and animals are unloaded and cars cleaned out. Weeds thus get started in the railway yards and spread to the neighbouring farms. It is claimed that the Russian Thistle was introduced into New Ontario in this way.

Farm implements such as the cultivator and harrow are responsible for the spread of many weeds from one field to another, the creeping root-stocks of perennial weeds adhering to the teeth. Weeds spread in this manner are Field Bindweed, Twitch Grass and Perennial Sow Thistle. Fresh farmyard manure is very often full of weed seeds and should be piled and allowed to heat thoroughly before it is applied to clean land.

CLASSIFICATION OF WEEDS

Weeds may be classified according to the length of time they live, as follows:

Annuals, or weeds which germinate, bloom, fruit and die in one year or season. Wild Mustard is an example.

Winter Annuals, which germinate late in summer or autumn, pass the winter as seedlings or immature plants, and complete the cycle of their existence by blooming, fruiting and dying during the following summer. Such are Chess and Shepherd's Purse.

Biennials, which produce leaves and roots the first year, and flowers and seeds the second year, after which they die. The Wild Carrot and Evening Primrose are familiar examples.

Perennials, which last from year to year, blooming and seeding every year. These are divided into two classes:

- (a) Those with underground creeping stems, such as the Canada Thistle.
- (b) Those with roots which do not spread underground, such as Chicory, Plantain and Dock.

It is important to know the class to which a weed belongs, as the method of eradicating an annual is often very different from that required to destroy a perennial.

COLLECTION AND IDENTIFICATION

Not only every seedsman, but every farmer and every teacher in a rural school should have a collection of weed seeds for reference and comparison, in order that he may be able to detect and identify such seeds when they are in grass seed, clover seed, rape seed, or any other kind of seed which is sold or offered for sale. A good collection can be made easily in the summer months. All that is necessary is a number of small bottles and a little attention at the right time. The so-called homeopathic vials of one-drachm capacity are suitable for the purpose, but they should be carefully and plainly labelled. If they are not so labelled, the collection will be valueless.

A small magnifying glass is very useful in identifying seeds. Perhaps the most convenient glass for the purpose is the tripod magnifier (Fig. A), costing about one dollar. The linen-tester (Fig. B) is cheaper, but yet quite serviceable.

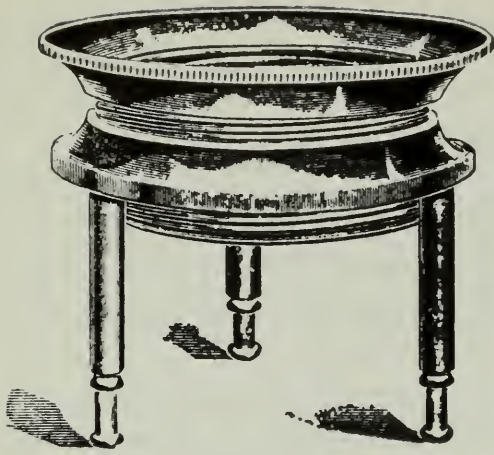


Fig. A. Tripod Magnifier

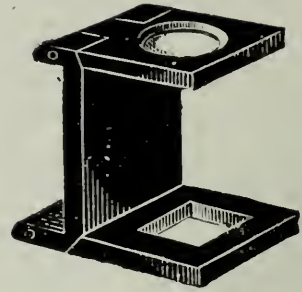


Fig. B. Linen Tester.

GENERAL PRINCIPLES IN THE CONTROL OF WEEDS

1. Never allow weeds to mature seeds. Cut those on the roadsides, headlands, in waste places and in the fence corners, as well as those in the fields.
2. Be constantly on the watch for the appearance of new weeds. Do not wait until a weed has become established before finding out what it is. It is a comparatively easy task to get rid of a few plants of Perennial Sow Thistle, but a long, tedious and costly operation to clean a field which has become overrun by it.
3. Sow only pure seed. Impure seed is dear at any price. Pure seed is the purchaser's right by law, and he should insist upon having it. Everyone who has to purchase agricultural seeds should have sufficient knowledge of The Dominion Seeds Act to be able to realize the value of the various grades of seed defined by the Act and under which grade names agricultural seeds are sold in Canada. No seed grain, clover or grass seed should be sown without ascertaining its weed seed contents. Any farmer can have his seeds examined and reported upon as to purity by submitting samples to a Dominion Seed Laboratory (see page 11).
4. In dealing with perennial weeds with creeping underground "roots," be careful not to harrow or cultivate through patches and drag the "roots" all over the field.
5. See that the separator is cleaned before being brought upon the farm and that it is fitted with screens to prevent weed seeds going out in the straw or getting into the grain. Burn or bury the refuse from the separator and do not throw it around the barnyard or on the manure heap or use it for chicken or hog feed.
6. Avoid feeding stock upon chop containing weed seeds in any quantity. Such food should be boiled before being fed.

ERADICATION OF WEEDS

The most important points under this head are:

First, a determination to get rid of weeds and to keep the land clean.

Second, the method or methods of tillage and cropping.

For various reasons, very few farms in the older sections of the Province of Ontario are free from weeds, and the question how to clean our lands without incurring too much expense is one of the most important which can engage the attention of Ontario farmers.

In the first place, all obstructions to cultivation, such as piles of stone, must be removed—hailed away to the woods or an out-of-the-way corner in the winter or some other slack time. Secondly, places for harbouring weeds, such, for example, as snake fences, should be got rid of as soon as possible

Annuals and Biennials. Wild Oats, Wild Mustard seed, and some other seeds belonging to these classes, have great vitality. If down pretty well beyond the reach of the air, they will live for years, and will germinate as soon as they are brought near the surface.

The best way to destroy annuals and biennials is by thorough and frequent shallow cultivation early after harvest in stubble ground and in sod plowed for the following year, and at the proper season (spring and summer) among what are called "hoed crops," that is, potatoes, carrots, turnips, mangels, Indian corn, etc. By shallow cultivation the seeds are kept near the surface, and by frequent stirring of the soil they are made to sprout; and, having sprouted, they can be killed by further cultivation. Those which sprout late in the fall are destroyed by the winter frost. It is impossible to get rid of such weeds by plowing the ordinary depth, say seven or eight inches, once in the fall or at any other time. Plow shallow (not more than four inches in sod and three inches in stubble ground), and harrow and cultivate frequently, as by each stirring of the soil fresh seed is made to sprout, and what has already sprouted is destroyed. When necessary to loosen the soil to a greater depth, use a grubber or subsoil plow.

Perennials. It is necessary to study the habits of perennial weeds to see how they grow and propagate themselves from year to year, in order to keep them in check; and a close examination of almost any of them will show that the buds from which the young plants start are near the surface of the soil. Hence shallow cultivation, similar to that mentioned above, is the effective method of destroying them. Disc harrows cut the shallow, creeping "roots" into fragments, which bud and greatly increase the difficulty of eradication. Deep plowing only transplants the buds to a greater depth, and increases the trouble. Plow shallow (see preceding paragraph), and harrow and cultivate frequently, using a grubber or subsoil plow when it is necessary to stir the soil to a greater depth. As above, the cultivation must be early after harvest and throughout the fall in stubble ground and sod, and in spring and summer among corn, potatoes and root crops. Ill-timed, irregular or partial cultivation only makes all weeds grow more vigorously. Plan so that fields over-run with perennial weeds such as Twitch Grass and Perennial Sow Thistle receive the maximum amount of cultivation during the driest and hottest part of the summer.

GENERAL METHODS FOR THE ERADICATION OF WEEDS

1. Crop Rotation

Crop rotation is of utmost importance in dealing with weeds. Some sharp, short rotation of crops should be adopted, which will allow of the frequent use of the cultivator, the cutting of the weeds before seeding and the introduction of smother or hoed crops. One cannot recommend a system of cropping that will be suitable to all kinds of farming. Each farmer must select the rotation most suited to his conditions, keeping in mind those features of rotation which will enable him to fight the particular weed with which he has to contend.

The following rotation is recommended for Eastern Canada by Doctor E. S. Hopkins, Dominion Field Husbandman:

First year—grain.

Second year—corn or other inter-tilled crops.

Third year—grain seeded down.

Fourth year—clover hay.

Fifth year—timothy or pasture.

This rotation has the advantage of providing considerable opportunity for cultivating the land, which is necessary to kill weeds. If Couch-grass or other perennial

weeds are present the timothy sod should be plowed about August first, immediately after the hay has been removed. Thorough cultivation should then be given during the remainder of the fall and the land replowed again in the late fall. In the following spring the land should be well cultivated before the grain is seeded, and after the grain crop has been removed the land should be plowed and thoroughly worked during the fall.

In the second year of the rotation, the inter-tilled crop should be thoroughly worked. This rotation provides ample opportunity to thoroughly work the land and thereby control weeds satisfactorily. However, unless the land is thoroughly worked, the rotation itself will not be a success.

2. Hoed Crops

The growing of such crops as potatoes, corn and roots provides a means by which many weeds may be effectively fought. Hoed crops alone do not give entire satisfaction in fighting creeping perennial weeds. This is due to the fact that in cultivating and hoeing the root-stocks are cut but not all destroyed, and in a short time begin to grow again. Hoed crops, therefore, should not be depended upon alone to eradicate creeping perennials, but should be used in connection with other methods as outlined further on.

3. Summer Fallowing

This method is extremely efficacious in some seasons with all sorts of weeds, including the Perennial Sow Thistle. By fallowing for weeds a bare fallow is understood, that is, one which is given sufficient cultivation to prevent weeds from making any growth above the ground. A neglected fallow is nothing more or less than a weed patch and is useless and a source of contamination for every field on the farm. Summer fallowing for the whole season is objectionable, because it is costly, a season's crop is lost, considerable labour is required, and valuable plant food materials are leached from the soil. It is usually better, therefore, to fallow only for a portion of the season, either before putting in a hoed crop or smother crop, or immediately after breaking up meadows or pastures.

4. Early After-harvest Cultivation

This is one of the best ways to destroy annual and winter annual weeds, such as False Flax, Corn Cockle and Wormseed Mustard. Plow shallow immediately after harvest and harrow and cultivate frequently. By the shallow plowing the weed seeds are kept near the surface, and by the frequent stirring of the soil they are made to sprout and, having sprouted, they are easily destroyed by further cultivation.

5. Seeding Down

Many weeds can be suppressed or held in check by seeding to grass for hay or pasture. Alfalfa and sweet clover are excellent for this purpose. This method has the advantage of requiring little labour, which is expensive at the present time. Cutting the hay crop early will prevent most weeds from maturing any quantity of seed. Close pasturing, especially with sheep, will in time destroy most weeds, even perennials.

6. Weeds in Permanent Pastures

In Ontario there is a large acreage of pasture land which cannot be cultivated and brought under crop rotation. Much of this land is weedy and produces comparatively little pasture. Recent work on pasture improvement done in this Province and other parts of the Dominion indicates very clearly that such pasture land may be freed from many weeds and made to yield more abundantly by the judicious use of commercial fertilizers, in combination with good management, including in some cases reseeding with a suitable pasture mixture.

7. Sheep Destroy Weeds

A flock of sheep will do much to keep a farm free from weeds, and it is to be deplored that sheep are not more generally kept upon Ontario farms. **“When an abundance of succulent pasture of the finer grasses is provided, weeds can scarcely be said to be favoured by sheep as a staple part of their diet. Sheep will, however, even when good pasture is provided them, vary their diet by nipping off seedling plants or the fresh growing parts and the bloom with its contents of sweets from older plants of many of our common weeds. When their pasture is depleted, sheep feed readily on Wild Mustard, Ox-eye Daisy, Yarrow, Plantain, Perennial and Annual Sow Thistle, Wild Vetch or Tare, Dock, Sorrel, Lamb’s Quarters, Milkweed, Ragwort, Burdock and Shepherd’s Purse. In fact, there are few weeds that sheep will not eat, to the extent of preventing them from seeding, if there is not enough of their favourite grasses to satisfy them. It is only when the supply of food is unusually short that sheep will feed on plants having leaves and stems covered with bristly hairs or spines, or with a flavour that is obnoxious to them. When the plants are young and tender, however, sheep have been observed to eat such weeds as Ragweed, Blueweed, Cockle, Orange Hawkweed, Hound’s Tongue, Stickseed, Mullein, Canada Thistle, Stinkweed, Toadflax and others that are bristly or have a pungent flavour. Thorough cultivation with a systematic rotation of crops, combined with the maintenance of as many sheep as can be kept to advantage, is a certain and profitable means of keeping weeds under control.”*

8. Smothering

The aim of this method is to kill weeds by depriving them of light and air. This is accomplished by getting some quick-growing crop, such as rape or buckwheat, established on the land while the weeds are in a weakened condition. The result is that the smother crop soon occupies every available foot of the land and forms a dense shade in which the weeds in their weakened state cannot continue to grow. Smother crops give the best results when they follow intensive cultivation.

9. Hand Pulling

Hand pulling and a total removal of weeds is the most effective means of destruction, but of course is only practical with shallow-rooted weeds, not very abundant in a field. Weeds in a clover seed crop should be hand pulled. By this method it is easier to prevent weed seeds from getting into clover seed than it is to remove them after they get in. Small patches of perennial weeds can be destroyed by digging out the plants with a fork, “roots” and all, and burning them. Great care must be taken to get every bit of the “roots.” Then the spots which have been dug over should be watched, and if new shoots appear they should be taken out at once. In an ordinary season several diggings will be required in order to completely exterminate a creeping perennial.

10. Pure Seed

The importance of sowing pure seed only, cannot be too strongly emphasized. Impure seed does much to aggravate the weed problem of Ontario. Clover and grass seed especially should receive the closest care and scrutiny. In the past, either through ignorance or carelessness, far too much impure clover and grass seed has been sown in this Province. Out of some 235 samples of clover and grass seed examined for purity by this Department, 76 were rejected on account of containing weed seed impurities in excess of those allowed by The Dominion Seeds Act. Everyone interested in clean farming should learn to know the common weed seed impurities of commercial seeds, and have sufficient knowledge of The Dominion Seeds Act to enable him to purchase his seed with an intelligent appreciation of the values of the various grades.

*Farm Weeds of Canada.

11. Maintenance of Soil Fertility

Too much emphasis cannot be placed upon the value of maintaining a high level of soil fertility as an aid in weed control. Well-nourished, vigorous, healthy crops smother out seedling weeds and prevent them from getting established in the field. This is especially true of cereal and hay crops. It is in thin, weakly, starved crops that weeds flourish and take possession of the land.

WEED CONTROL IN PASTURES

By N. J. Thomas—Pasture Research

A thick sod of vigorous pasture plants resulting from productive soil is the best method of weed control in pastures.

Many of our pastures are composed of over fifty per cent of weeds, the kinds depending upon the soil type, acidity or alkalinity of the soil and drainage. On light, well-drained sands and gravelly soils, Mullein, Blueweed, Bladder Campion and Ox-eye Daisy predominate. On heavier, well-drained soils, Canada Thistle, Curled Dock, Fleabane, Ox-eye Daisy, Dandelion, Yarrow and Goldenrod are very common. On poorly drained soils, Buttercup, Perennial Sow Thistle, Horsetail, Water Smartweed and Sedges occur, and usually indicate a water-logged condition of the soil. Chicory, Wild Carrot, Rough Cinquefoil, Yarrow, Daisies and Canada Thistle occur most frequently on heavy soils. An abundant growth of such weeds as Sheep Sorrel, Wild Strawberry and King Devil is an indication of acid soils. The presence of King Devil, Poverty Grass and Silver Weed in quantities is indicative of low soil fertility.

One of the chief causes of weedy pastures is due to the killing out of the desirable species of pasture plants, leaving bare ground in which weeds quite easily take root and flourish without competition. This is brought about largely by poor pasture management, such as over-grazing in the early spring and late autumn, combined with low levels of soil fertility or poor surface drainage. Continued over-grazing results in the depletion of the plant food in the roots of the pasture plants. This causes them to kill out very easily in periods of extreme winter conditions or summer drought.

It is advisable and economical, when possible, to plow up and reseed thin, weedy pastures with a desirable pasture mixture and at the same time to apply plenty of barnyard manure or fertilizer to increase the fertility of the soil. For further information on pasture management, see Ontario Agricultural College circular No. 28 on "Pastures and Their Improvement." Increasing soil fertility by a top dressing in the early autumn or spring with lime where needed, manure and fertilizers, combined with good grazing management and the proper use of the mower, will encourage the development of desirable grass and clovers to such an extent that all weeds except the most hardy will be completely smothered out.

Discing and reseeding the sod of weedy pastures and applying fertilizers invariably results in increase of weeds, due to the sprouting of dormant weed seeds near the surface of the soil. At the same time a satisfactory stand of pasture is not obtained unless ample moisture is present.

The frequent use of the mower is excellent in the control of weeds. The time for mowing depends upon the kinds of weeds present. For the best results the weeds should be cut when they are in the early bloom stage. Usually, however, mowing in late June and again in early September will control the majority of weeds. Mowing in early June only will help to control many weeds, but such weeds as Blueweed, Thistles and Wild Carrot, when cut early, stool out again in midsummer, necessitating a second mowing. This second mowing is also necessary to control late-growing species, such as Rough Cinquefoil, Ragweed, King Devil, Canada Fleabane, Yarrow,

Thistles, Goldenrod, etc , all of which are very unpalatable to live stock. Many weeds such as Bladder Campion, Dandelion, Bindweed and Perennial Sow Thistle are quite tender when young and are readily eaten by live stock. Sheep are excellent for controlling Ox-eye Daisy and even Blueweed in the early stages, if grazing is rather thin. The most unpalatable weeds must, of course, be controlled by the use of the mower.

The presence of thorns and shrubs in pastures is largely due to poor management, which results in the killing out of favourable pasture species. As a result, the stock-carrying capacity of the area is greatly reduced. Under-grazing follows, and this allows thorns and other shrubs to develop. Thorns and shrubs when young and tender are readily controlled by live stock, but if allowed to develop and become woody the only satisfactory means of eradication is by digging or pulling them out with horses or tractor.

Controlling weeds in pastures by spraying with chemical weed killers is quite possible, but at the present time impracticable with large areas owing to the high cost per acre. With small patches of particularly noxious weeds it is a practicable means of control. The grass will recover quickly, but great care must be taken not to graze the sprayed areas until all traces of the spray materials are washed off by rain.

FARM MACHINERY FOR WEED CONTROL

The mechanical condition of the implements and their suitability for the particular soil and weeds determine their effectiveness in weed control.

The Plow

The ordinary plow, when properly adjusted and equipped with a suitable sharp share and skimmer, is one of the best implements for weed control. Clean-cut, well-turned furrows with all vegetation cut and buried results in the destruction of many weeds.

The Disc Plow

This implement is especially adapted for plowing gravelly or very hard clay soils in which the ordinary plow will not do the best of work. The rolling, cutting action of the disc ensures all weeds being cut off and left exposed to the sun. The disc plow leaves the soil very open and easily dried out, so it is very satisfactory for early, after-harvest cultivation or late fall plowing.

The One-way Disc

This implement is becoming very popular for shallow, after-harvest cultivation, and it is very efficient in destroying weeds. The working principle is similar to that of the disc plow. It can be drawn at relatively high speeds, so that it thoroughly breaks the soil and exposes the roots of the weeds to the hot sun. At the same time it causes the weed seeds in the soil to germinate, and the seedlings are destroyed by later cultivations.

The Broad-share or Duck-foot Cultivator

This is one of the best implements for after-harvest cultivation and for working summer fallow. The overlapping of the shares ensures the cutting of the roots of all weeds. It is very important that the shares be kept sharp if efficient work is to be done.

The Spring-tooth or Narrow-share Cultivator

This type of cultivator is especially designed for deep cultivation to loosen the soil in preparation for a seed bed. It is very useful for working fields badly infested with Couch-grass, Sow Thistle and Field Bindweed, as it brings the "roots" to the

surface of the ground. Occasional deep cultivation with the spring-tooth cultivator, followed by cultivation with the broad-share cultivator, has proved very effective in killing weeds.

The Disc Harrow

This implement is effective in killing many annual weeds when they are young. It is of comparatively little value in destroying perennials or well-established annual weeds.

The Row Crop Cultivator

This implement is essential for weed control in row crops. For the first few cultivations it should be equipped with narrow teeth for deep working of the soil and the destruction of seedling weeds. For later cultivations it should be fitted with broad shares which would ensure the cutting of all weeds.

The Weeder

The value of this implement cannot be over-emphasized for destroying weeds in the seedling stage. It can be used on all spring-sown crops such as oats, barley, peas and wheat, if the field is not seeded down. The weeder should be employed when the grain is about two to four inches high. The weeds will not only be killed, but a light mulch will be formed which will be of great benefit to the soil and crop. The frequent use of the weeder on row crops such as corn, potatoes and beans from soon after planting until the crop is about six inches high reduces the weed problem to a minimum. The weeder is even used on sugar beets, mangels and turnips just after they are up in the drills, and has proved very helpful in controlling weeds without injuring the crop.

A light set of spike-toothed harrows or lever harrows could replace the weeder on grain crops and such crops as corn, potatoes and beans, if used with care.

THE SEEDS ACT

*Administered by the Division of Plant Products Production Service,
Dominion Department of Agriculture*

By W. H. Wright, M.A.

The Seeds Act was devised to make possible the purchase of high-quality seed by those who wish to do so, and to prevent inferior seed being brought into Canada from other countries.

- (1) Grades are provided for all classes of agricultural and garden vegetable seeds.
- (2) Seed which is sold for the purpose of seeding must be graded, except in the case of garden vegetable seeds, when grading is optional; but nevertheless vegetable seeds must conform to the minimum standard of purity and germination required by regulations.
- (3) The Act does not apply to:
 - (a) seed that is sold to be cleaned or graded before being offered for sale for the purpose of seeding;
 - (b) seed that is held in storage for the purpose of cleaning or grading, provided that the place of storage is not accessible to purchasers of seed or the seed is labelled "held for recleaning";
 - (c) the seeds of cereal grains, buckwheat, field peas, field beans and corn that are grown, sold and delivered by any farmer, on his own premises, for seeding by the purchaser himself, unless the purchaser of the said seed obtains from the seller at the time of the sale thereof a certificate

- that the said seed is supplied to him subject to the provisions of this Act;
- (d) the sale of Elite stock seed that may be produced and sold by any plant breeder to a seed grower, unless such seed be again sold.

(4) Alfalfa, clovers and grasses sold for seeding, either singly or in mixtures, are not exempt under any conditions and must be graded even when sold by one farmer to another on his own premises.

(5) There are eleven grades of seed in use:

- (a) Registered No. 1, Registered No. 2, and Registered No. 3. This seed is derived from field-inspected crops of known pedigrees and approved varieties for which Registration Certificates are issued by the Canadian Seed Growers' Association. This class of seed must be practically free from weed seeds and disease, and must have a very high percentage of viable seeds; or, in other words, must have a high percentage of germinable seeds. This does not mean a high percentage of seeds which show signs of life when grown, but seeds which are healthy and normal, capable of producing a plant under favourable field conditions. Registered seed can only be sold in sealed containers bearing a government tag and seal.
- (b) Certified Seed, Grades No. 1 and No. 2. This is not quite such high-quality seed as Registered, but it is also field inspected and sold in containers bearing Seed Inspection Certificate Tags and Seals.
- (c) Seed of Commerce—seeds which are not eligible for registration come in this group. The grades are No. 1, No. 2, No. 3, No. 1 Mixture, No. 2 Mixture and No. 3 Mixture. These grades are based on the following characters:
- (i) Freedom from weed seeds.
 - (ii) Viability or ability to produce plants under the most favourable conditions.
 - (iii) Freedom from the seeds of other cultivated plants.
 - (iv) Freedom from disease.
 - (v) General quality: plumpness, soundness, colour, uniformity, freedom from chaff and dirt.
 - (vi) Purity of variety when this can be determined from seed characters.

(6) Use of false or spurious variety names or misleading statements as to quality, grade, character or description of either seeds or plants is illegal.

(7) Sweet clover is considered to be a cultivated seed only when graded and sold as sweet clover; otherwise it is classed as a weed seed.

(8) Seeds cannot be imported into Canada for seeding purposes unless they conform to the minimum requirements of the Act.

(9) Seed-testing laboratories are established to give service to farmers, seedsmen and other interested persons at two points in Ontario. Persons living in Ontario west of Toronto and in the Counties of Ontario, York, Simcoe, Muskoka and Parry Sound should send samples for testing to the District Supervisor, P.O. Box 810, Station "F", Toronto. Those living elsewhere in Ontario should communicate with the District Supervisor, Plant Products Division, Jackson Building, Ottawa. Copies of The Seeds Act can be obtained at the above addresses.

Size of Sample Required

Five pounds of cereal grains graded registered and certified; *two pounds* of cereal grains graded No. 1 Seed, No. 2 Seed and No. 3 Seed; and *one pound* of beans (field, Soy), beets (sugar), mangel, peas (field), sunflower and vetches.

Eight ounces of corn (field), flax, lentils, sorghum and Sudan grass.

Four ounces of alfalfa, beet (garden), brome grass, clovers, crested wheat grass, lespedeza, meadow fescue, millet, rape, reed canary grass, rye grasses, sanfoin and timothy.

Two ounces of beans (garden), corn (garden), crested dog's tail, fescues (except meadow fescue), meadow foxtail, orchard grass, peas (garden), pumpkin, squash, swiss chard, tall oat grass, vegetable marrow and watermelon.

One ounce of colonial or P.E.I. bent, creeping bent, red top, velvet bent, Canadian blue grass, Kentucky blue grass, Poa triflora, rough-stalked meadow grass, wood meadow grass and turnip.

One-half ounce of asparagus, carrot, chicory, citron, cucumber (except greenhouse cucumber), leek, onion, muskmelon, parsley, parsnip, radish, salsify and spinach.

One-quarter ounce of artichoke, borecole or kale, broccoli, brussels sprouts, cabbage, chives, cress, endive, kohlrabi, lettuce, mustard, pepper and tomato.

One-eighth ounce of cauliflower, celery, celeriac, chervil, egg-plant, sage, savory and tobacco.

Twenty-five seeds of greenhouse cucumber.

DIRECTIONS FOR TAKING SAMPLES FOR GRADING

By W. H. Wright, M.A.

The grades issued by the Seed Branch are based on the general quality and tests for purity and germination which are made of the samples sent into the laboratories. Since these samples are necessarily small, it is most important that they should represent as accurately as possible the bulk of the seed from which they are taken. Very few farmers possess "the small Trier" and the larger "sticker" which are the regulation implements for taking samples. A farmer may have occasion to take samples of seed (a) during the process of cleaning, (b) from a bin, (c) from bags.

(a) *Taking samples while cleaning.* This is the best time to take samples. Frequent samples should be taken of the seed as it comes from the fanning mill and put together in a pile. This seed should then be carefully mixed again, then divided into four. One-quarter should be separated, mixed and quartered. This process should be carried on until a sample of the correct size for sending to a laboratory for testing is obtained.

(b) *Taking samples from bins* when there is not a sticker to hand is difficult. The best method is to take five samples from different places from the top and the same number by thrusting the hand as far as possible into the bin at different points. These samples should be mixed and quartered as already described.

(c) *Taking samples from bags.* When there is only one bag or a part of a bag it is often possible to empty the bag in a clean place, mix and take samples from three or four places in the pile. These samples should then be mixed together and quartered as already described. When there are several bags it is generally considered satisfactory to take two samples from each bag, one from the top and one by thrusting the hand well into the bag. These samples are then mixed together, quartered and requartered until a sample of desired size is obtained.

THE ONTARIO WEED CONTROL ACT

The seriousness of the weed situation in Ontario became apparent in the years immediately following the Great War of 1914-1918. Many factors were responsible for this situation. The necessary legislation was lacking which would form the basis for a provincial-wide weed control campaign and also provide a means whereby

pressure could be brought to bear upon those who failed to co-operate. Weeds, therefore, were permitted to mature seeds and thus reproduce their kind. Consequently there was a great increase in the number of weeds, especially those with seeds dispersed by the wind. Many ratepayers were fighting a losing battle and were becoming discouraged. Since crop production was becoming seriously affected, public opinion was aroused and action was demanded with the result that, in 1927, The Weed Control Act was placed on the Statutes of the Province.

The main object of this legislation is to provide a means whereby noxious weeds may be controlled by the co-operation of all concerned.

As the Municipal Council is the governing body which has the most intimate contact with the ratepayers, provision was made in the Act whereby each Municipal Council must appoint and pay at least one Weed Inspector. Those weeds which are considered the worst in the Province are listed as noxious, and it is the duty of each Weed Inspector to make a thorough inspection of his municipality as often as it is necessary to see that such weeds are destroyed before there is any possibility of their seeds maturing. The main clause or body of the Act states: "Every occupant of land or if the land is unoccupied the owner shall destroy all weeds designated noxious by the regulations as often in every year as is sufficient to prevent the ripening of their seeds."

The Municipal Council being responsible for the administration of the Act and for the maintenance of roads, it has been emphasized that the Council make every effort to keep roadsides reasonably free from weeds, thereby setting a good example to the ratepayers. Where the Municipal Council has taken care of its own property the Weed Inspector is in a position to make an inspection of his municipality and to check up on neglected areas. Each Weed Inspector is advised to be courteous and to use good judgment and common sense in his work, yet to be firm enough to enforce the Act where and when necessary.

A notice may be served by the Weed Inspector on any occupant or owner who fails to co-operate, giving him a definite number of days in which to do the work. If nothing is done within the specified time, the Weed Inspector may have the work done and charge the costs against the property, to be collected in the same manner as taxes. Court action and penalties are also provided for in the Act, and may be resorted to by the Weed Inspector if all other efforts fail. Fortunately the number of cases where it has been necessary to enforce the Act have been very few, and it is gratifying to know that this situation is improving each year.

Those in authority, realizing the necessity of controlling the dispersal and disposal of weed seeds, included in the Act sections that state: first, that threshing machines and all equipment must be thoroughly cleaned before leaving the farm to go to the farm of another, or before travelling upon any public roadway; second, that refuse containing weed seeds from grain elevators, grist mills, flour mills and seed-cleaning plants must be disposed of in such a manner that such weed seeds do not create a weed menace; third, that it is contrary to law to deposit or permit to be deposited any noxious weeds or weed seeds on neighbouring or other property.

District Weed Inspectors are appointed by the Department of Agriculture, their duty being to act in a supervisory capacity. Assistance is given to Municipal Councils and Weed Inspectors with their problems, and every effort is made to have a uniform administration of the Act and an improvement in the weed situation each year.

Municipal Councils are elected by the ratepayers to safeguard their public interests. When weeds and weed seeds become a menace to neighbouring and other property, weed control becomes a public problem. It is the duty of each Municipal

Council through its Weed Inspector to see that everyone receives the protection to which he is entitled under this Act.

The Ontario Weed Control Act provides the means whereby noxious weeds may be prevented from becoming a public menace. However, the Act itself will not control a single weed. Any results accomplished must be brought about by definite human action. The co-operation of every individual and every governing body is essential in controlling this weed menace to agriculture.

An effort has been made in this article to briefly outline the main provisions of The Weed Control Act, a copy of which will be forwarded gladly to anyone on request.

REGULATIONS, THE WEED CONTROL ACT, REVISED STATUTES OF ONTARIO, 1937

(1) The following plants shall be deemed noxious weeds:

Class "A"

Bindweed (*Convolvulus arvensis*, L.).
Bladder Champion (*Silene latifolia*, Mill, Britten & Rendle).
Canada Thistle (*Cirsium arvense*, L., Scop.).
Dodder (*Cuscuta species*).
Hemp (*Cannabis sativa*, L.).
Pepper Grasses (*Lepidium species*).
Sow Thistle, Perennial and Annuals (*Sonchus species*).
Spurges (*Euphorbia species*).
Wild Carrot (*Daucus carota*, L.).

Class "B"

Arkansas Bedstraw (*Galium arkansanum*, Gray).
Blue Weed (*Echium vulgare*, L.).
Chicory (*Cichorium intybus*, L.).
Cinquefoils (*Potentilla species*).
Common Burdock (*Arctium minus*, Bernh.).
Common Milkweed (*Asclepias syriaca*, L.).
Common Ragweed (*Ambrosia artemisiifolia*, L.).
Docks (*Rumex species*).
Hawkweeds (*Hieracium species*).
Ox-eye Daisy (*Chrysanthemum leucanthemum*, L.).
Poison Ivy (*Rhus toxicodendron*, L.).
Russian Thistle (*Salsola kali*, var. *tenuifolia*, G. F. W. Mey).
St. John's-Wort (*Hypericum perforatum*, L.).
Stinkweed (*Thlaspi arvense*, L.).
Tumbling Mustard (*Sisymbrium altissimum*, L.).
White Cockle (*Lychnis species*).
Wild Lettuces (*Lactuca species*).
Wild Mustards (*Brassica species*).

Kinds of Weed Seeds to be Looked for in Grass and Clover Seeds

The following are the more frequent impurities found in the various kinds of grass and clover seeds:

In Alfalfa. Ribgrass or buckhorn, ragweed, chicory, dock, dodder, wild carrot, bladder champion, green foxtail, lamb's quarters, sweet clover, pale plantain, Russian thistle, yellow foxtail, barnyard grass, black medick, smartweed.

In Red Clover. Ribgrass or buckhorn, bladder campion, white cockle, night flowering catchfly, dock, ragweed, Canada thistle, wild carrot, false flax, green foxtail, lamb's quarters, pale plantain, black medick, sheep sorrel, sweet clover, common plantain, mayweed, knotweed, pigweed and field pepper grass.

DESCRIPTION OF THE WEED SEEDS ILLUSTRATED

1. GREEN FOXTAIL. Colour, brown, often mottled with lighter spots, greenish yellow with the hull on; shape, oval, blunt at both ends, one face flattened and the other rounded; size, $\frac{1}{12}$ of an inch long; the surface granular striate. Yellow Foxtail seed is brown, larger, about $\frac{1}{8}$ to $\frac{1}{10}$ of an inch long and surface conspicuously wrinkled crosswise.

2. CHES. Straw-coloured; somewhat boat-shaped, back rounded; seven-nerved; size, about $\frac{1}{3}$ of an inch long; surface deeply creased on one face with a row of spines near each margin.

3. WILD OATS. Brownish black to straw colour; oat-shaped with a conspicuous sucker-mouth scar at the base; $\frac{3}{4}$ of an inch long; surface hairy, especially towards the base, and with a strong, bent and twisted awn on the back.

4. COUCH-GRASS. Straw-coloured to dirty gray; size, $\frac{1}{2}$ to $\frac{3}{8}$ of an inch long; narrowly boat-shaped with hull on, very narrowly wheat-shaped with hull off; surface indistinctly nerved on the rounded face; sometimes with a short awn.

5. CURLED DOCK. Colour, reddish brown; beechnut or buckwheat shaped; $\frac{1}{12}$ to $\frac{1}{8}$ inch long; smooth and shiny on the surface.

6. SHEEP SORREL. Brown to ash-brown in colour; buckwheat or beechnut-shaped; about $\frac{1}{20}$ of an inch long; surface of the hull very finely ridged, surface of the seed itself smooth and shiny.



The small drawings beside the enlarged drawings represent the natural size of the seeds.

7. LAMB'S QUARTERS. Colour, shiny black with hull off; usually covered with finely granular grayish hull; lens-shaped with a projection at one side; size, about $\frac{1}{16}$ of an inch in diameter; surface of seed smooth; hull finely granular.

8. PURSLANE. Colour, dull black; irregularly egg-shaped with a notch at the small end; size, about $\frac{1}{16}$ of an inch in length; surface covered with rows of indistinct blunt tubercles.

9. CORN COCKLE. Black or dark reddish brown in colour; very irregular in shape, usually somewhat kidney-shaped or angular; about $1/12$ to $1/8$ of an inch in length; surface covered with regular rows of distinct spines or teeth.

10. BLADDER CAMPION. Colour, light brown to brownish gray; kidney-shaped, varying to somewhat angular or heart-shaped, usually with conspicuous depressions near the scar; $1/14$ to $1/16$ of an inch in length; covered with pointed tubercles arranged in regular rows.

11. WHITE COCKLE. Light ash colour; kidney-shaped; about $1/16$ of an inch in length; surface covered with blunt tubercles arranged in regular concentric rows.

12. NIGHT FLOWERING CATCHFLY. Colour, grayish brown; kidney-shaped; about $1/14$ to $1/16$ of an inch in length; surface covered with blunt tubercles, which are very close together and not in regular and definite rows.

13. PEPPER GRASS. Colour, reddish yellow to reddish brown; about $1/12$ of an inch in length; egg-shaped in outline but flattened with a slight wing around the margin; the surface with a conspicuous curved groove about two-thirds the length of the seed.



The small drawings beside the enlarged drawings represent the natural size of the seeds.

14. PENNY CRESS. Colour, purplish or bronzy brown; egg-shaped but flattened, with a minute notch at the small end; about $\frac{1}{12}$ of an inch in length; surface covered with conspicuous, wavy, eccentric ridges which start and end near the small end of the seed.

15. WILD MUSTARD. Reddish brown to slate black in colour; spherical; $\frac{1}{16}$ of an inch; surface smooth with an inconspicuous scar.

16. WORMSEED MUSTARD. Colour, reddish yellow with a dark spot at the large end; irregularly carrot-shaped; about $\frac{1}{24}$ of an inch in length; surface with a distinct longitudinal groove.

17. SHEPHERD'S PURSE. Colour, yellowish red; somewhat U-shaped; about $\frac{1}{25}$ of an inch in length; usually with two distinct grooves on each surface.

18. SMALL-SEEDED FALSE FLAX. Colour, reddish brown with a minute whitish spot at the small end; somewhat oval in shape; about $\frac{1}{20}$ of an inch in length; the surface very finely granular roughened and grooved lengthwise.

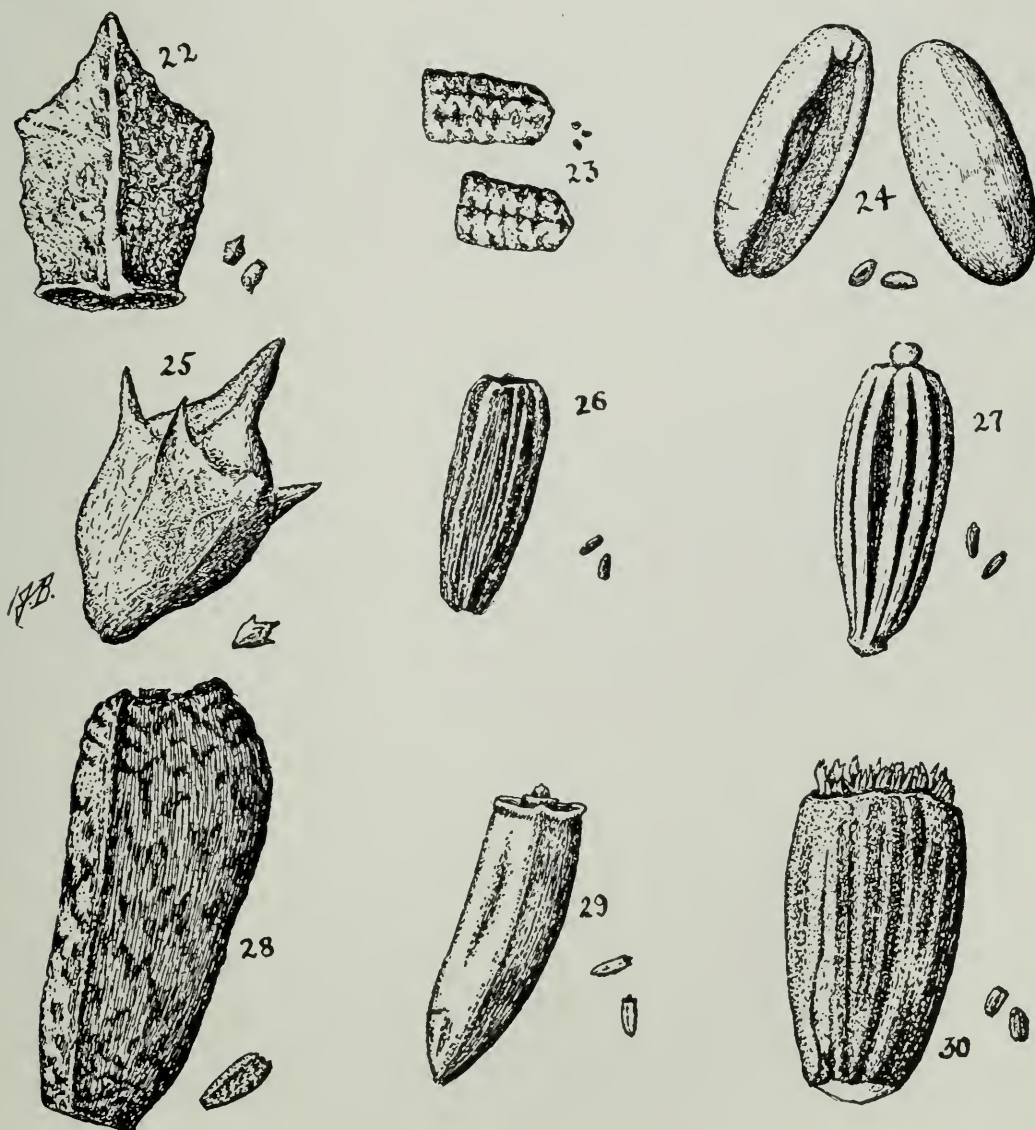
19. FIELD BINDWEED. Colour, gray-brown or seal-brown; irregularly pear-shaped; about $\frac{1}{8}$ to $\frac{1}{6}$ of an inch in length; surface coarsely roughened.

20. DODDER. Colour, yellowish to gray-brown; somewhat egg-shaped; ranging in size from $\frac{1}{16}$ to $\frac{1}{24}$ of an inch in length; surface minutely roughened.

21. HOUND'S TONGUE. Grayish brown in colour; somewhat pear-shaped in outline; about $\frac{1}{8}$ of an inch long; surface covered with hooked prickles.

22. BLUE WEED. Colour, grayish or blackish brown; somewhat irregularly mitre-shaped, with a triangular scar at the base; about $\frac{1}{8}$ of an inch in length; surface irregularly roughened and pitted.

23. MULLEIN. Light brown in colour; somewhat thimble-shaped; about $\frac{1}{25}$ of an inch in length; surface pitted, with zig-zag ridges between the pits.



The small drawings beside the enlarged drawings represent the natural size of the seeds.

24. RIBGRASS. Colour, amber brown to dark brown; datestone-shaped or boat-shaped; about $1/12$ of an inch in length; surface smooth, except for a scar in the hollowed-out face.

25. COMMON RAGWEED. Greenish straw-coloured to brown; somewhat top-shaped, with a number of blunt spines around the apex; $1/12$ to $1/8$ of an inch in length; surface with faint longitudinal lines ending in the spines. The seed proper is a little, pear-shaped, green body, but is usually enclosed in the hull described above.

26. YARROW. Colour, bluish gray or brown with white edges; oblong, wedge-shaped, flat; $1/16$ to $1/12$ of an inch in length; surface with very indistinct irregular longitudinal lines.

27. OX-EYE DAISY. Colour, gray and white or black and white; somewhat club-shaped, with a small knob at the large end; about $1/12$ of an inch in length; surface with twelve slender, conspicuous, white, longitudinal ribs.

28. BURDOCK. Colour, light brown, mottled with darker brown spots; shape prismatic, curved, tapering towards the base; $1/6$ to $1/4$ of an inch in length; surface slightly roughened, with a number of indistinct longitudinal ridges.

29. CANADA THISTLE. Colour, light brown; shape, narrowly oblong, pointed at the base and often curved with a rim and nipple at the apex; about $1/8$ of an inch in length; surface smooth, sometimes with a central longitudinal ridge.

30. CHICORY. Straw-coloured to dark brown, often light brown, mottled with dark brown; shape, prismatic to cylindric or somewhat wedge-shaped with a crown of scales around the top; about $1/12$ to $1/8$ of an inch in length; surface with fine irregular longitudinal lines.



The small drawings beside the enlarged drawings represent the natural size of the seeds.

31. PRICKLY LETTUCE. Colour, greenish brown to brown mottled with dark brown; lance-shaped with a slender prominent beak; size, about $\frac{1}{6}$ of an inch long; surface with five to seven longitudinal lines.

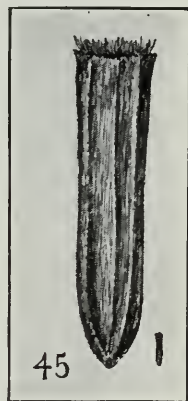
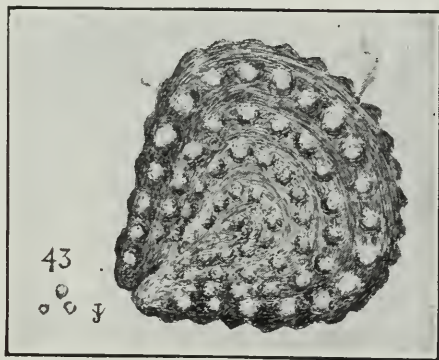
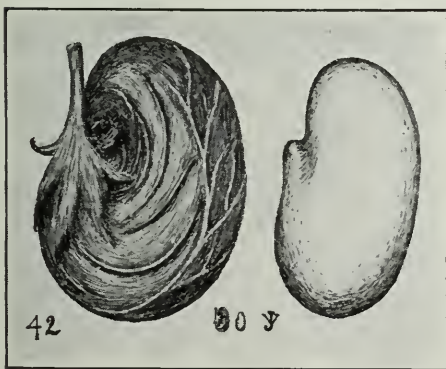
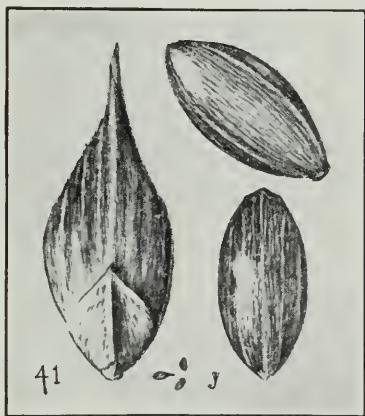
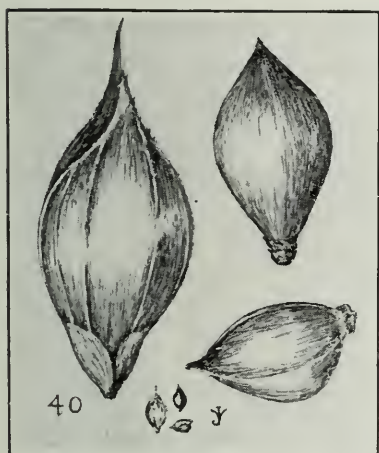
32. SPINY ANNUAL SOW THISTLE. Colour, reddish brown; flat, narrowly oval in outline; about $\frac{1}{8}$ of an inch in length; surface with three to five smooth ridges on each face.

33. PERENNIAL SOW THISTLE. Colour, dark reddish brown; somewhat spindle-shaped or oblong; about $\frac{1}{8}$ of an inch in length; surface deeply and closely ridged lengthwise, the ridges cross-wrinkled.

34. FLEABANE. Colour, yellowish or greenish brown; narrowly oval in outline, with a few scattered hairs at the top; $\frac{1}{14}$ to $\frac{1}{8}$ of an inch in length; surface covered with fine, indistinct, longitudinal lines.

35. DANDELION. Straw colour to red-brown; somewhat lance-shaped in outline; $\frac{1}{10}$ to $\frac{1}{8}$ of an inch in length; surface with distinct ridges running lengthwise, ending in barb-like teeth pointing towards the apex, which terminates in a prominent beak.

36. WILD CARROT. Colour, yellowish or light brown; oval in outline; about $\frac{1}{8}$ of an inch in length; rounded surface, ridged, and bearing four rows of spines.



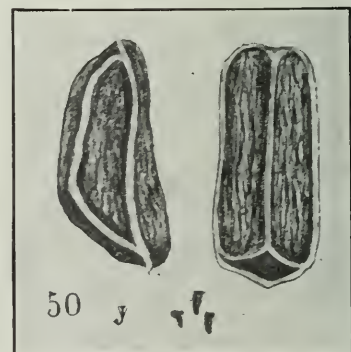
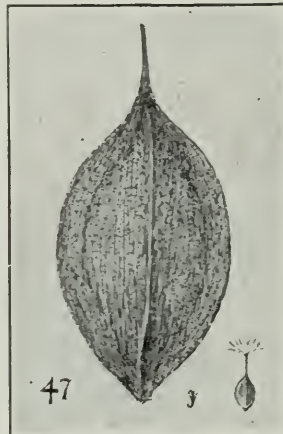
The small drawings beside the enlarged drawings represent the natural size of the seeds.

37. PIGEON WEED. Colour, grayish brown; somewhat irregularly pear-shaped with an elliptical scar at the base; about $\frac{1}{8}$ of an inch in length; surface irregularly pitted and ridged.

38. BROAD-LEAVED PLANTAIN. Colour, greenish brown to brown; shape very irregular, but somewhat angular oval in outline; about $\frac{1}{20}$ of an inch in length; surface covered with a fine, indistinct network and with a distinct scar on one face.

39. PIGWEED. Colour, dark reddish brown to jet black; egg-shaped with a minute notch at the small end; about $\frac{1}{24}$ of an inch in length; surface smooth and polished.

40. BARNYARD GRASS. Colour, usually greenish or grayish yellow; somewhat mandoline-shaped; about $1/10$ of an inch long; surface smooth and glossy.
41. OLD WITCH GRASS. Greenish yellow in colour; oval in outline, one face somewhat flattened; about $1/16$ of an inch long; surface smooth and shiny.
42. BLACK MEDICK. Seed found in a black, ribbed pod; yellow in colour; egg-shaped with a minute nose-like projection on one side; about $1/12$ of an inch in length; surface smooth.
43. COMMON CHICKWEED. Colour, reddish gray to dirty gray; shape, flat, somewhat kidney-shaped, with a small notch at the point; size about $1/24$ of an inch in length; surface covered with fine blunt tubercles in four or five distinct rows.
44. ROUGH CINQUEFOIL. Colour, light yellowish brown; somewhat comma-shaped; $1/30$ to $1/25$ of an inch in length; surface covered with curved, branched, longitudinal lines.
45. ORANGE HAWKWEED. Reddish brown to jet black in colour; somewhat torpedo or cigar-shaped; about $1/12$ of an inch in length; surface grooved lengthwise.
46. CONE FLOWER, YELLOW DAISY OR BLACK-EYED SUSAN. Dull black or brownish black in colour; four-sided and peg-shaped; about $1/12$ of an inch in length; very fine longitudinal lines on each face.
47. WILD OR CANADA LETTUCE. Dark brown to black in colour; shape, thin, flat and oval with a slender beak; about $1/6$ of an inch in length; surface with faint cross ridges.
48. WILD BUCKWHEAT, BLACK BINDWEED. Jet black in colour, often covered with a light brown or fawn-coloured husk; buckwheat-shaped; about $1/8$ of an inch in length.
49. HEAL ALL OR SELF HEAL. Brownish in colour; oblong, oval, tapering to a small, white, triangular scar at the base; about $1/12$ of an inch long; surface with dark lines on the margins and centres of the face.
50. EVENING PRIMROSE. Reddish brown in colour; very irregular in shape: some seeds are pyramidal, some prismatic and others wedge-shaped, all with four or five faces; about $1/16$ of an inch in length; each face very minutely ridged.



The small drawings beside the enlarged drawings represent the natural size of the seeds.

THE HORSETAIL FAMILY (EQUISETACEAE)

Field Horsetail, or Scouring Rush (*Equisetum arvense*, L.)—Fig. 1

This plant is found in damp grasslands, in low places in cultivated fields, and on apparently dry, sandy land which has a poorly drained subsoil. If fed in quantity in hay it is poisonous to horses. It is an extremely difficult pest to eradicate.

Description. Field Horsetail is a perennial weed with creeping, branching root-stocks with tuber-like swellings. Two kinds of shoots are sent up by the root-stocks, namely reproductive and vegetative. The reproductive shoots appear early in the



Fig. 1. Field Horsetail (*Equisetum arvense*).



Fig. 2. Green Foxtail (*Setaria viridis*).

spring. They are pale, cylindrical, unbranched, leafless stems 4 to 12 inches high. They are hollow, grooved and jointed, each joint being sheathed with a ring of pointed brown scales. Each shoot terminates in a yellowish or brown cone-like structure. The vegetative shoots seen later in the season are green, branched, tail-like structures. They are frequently described by correspondents as being like little pine trees. They are often conspicuous in cultivated fields.

Control. This weed thrives best in sandy or gravelly soil that is not well drained or where the underlying water table is not far from the surface of the soil. Good drainage, therefore, is the first essential in control, after which the land should be

enriched with farmyard manure, alone, or supplemented with a suitable commercial fertilizer, and its acidity corrected by applying lime if necessary. Then the field should be thoroughly cultivated. Hoed crops under a short rotation can be used to advantage in dealing with this weed. It may, however, take years of hard and persistent work to rid a badly infested field of this weed.

THE GRASS FAMILY (GRAMINEAE)

Green Foxtail (*Setaria viridis*, L., Beauv.)—Fig. 2

A weedy annual grass common in stubble, fallow and root fields; stems tufted, erect, simple or branched from the base, leafy, bearing dense, close, spike-like panicles which resemble millet, spikelets small, surrounded by from one to three persistent green bristles. The seed is greenish brown, often mottled with lighter spots. It is greenish yellow with the hull on; shape oval, blunt at both ends, one face flattened, the other rounded; the surface finely and indistinctly granular striate. The seeds are frequently found as an impurity in clover and grass seeds.

Time of flowering, July to September.

Time of seeding, August to October.

Control. Give repeated and thorough after-harvest cultivation. If a field is very badly infested with Foxtail, put in a hoed crop (potatoes, roots or corn) next spring and cultivate thoroughly throughout the season. Follow with a grain crop seeded with clover, without plowing after the hoed crop. *"Thick seeding with clover and grasses will help to suppress Foxtail in autumn stubble and subsequent clover crop. In clover seed crops the patches that have been winter-killed should be mown while the Foxtail is still quite green. The cut this time may be of value for fodder, and the increased market value of the clover seed will more than repay the cost of labour. Any practice that will prevent this annual from seeding will reduce and ultimately eradicate it."

Yellow Foxtail (*Setaria glauca*, L., Beauv.)

A grass very similar to Green Foxtail and found in similar situations. It can, however, be distinguished from Green Foxtail by the less dense spike and the larger spikelets, surrounded by tawny yellow bristles. The seeds are larger than those of the Green Foxtail, usually brown in colour and with very distinct cross-ridges.

Control. The same as for Green Foxtail.

Chess, Cheat, or Wheat Thief (*Bromus secalinus*, L.)—Fig. 3

This is a weedy grass naturalized from Europe. It is a winter annual of from three to four feet high, with fibrous roots and rough, coarse leaves. The spikelets are large, dark green in colour and in loose panicles.

The seeds are straw-coloured, somewhat boat-shaped, the back being rounded. They are about $\frac{1}{3}$ of an inch long, and one face is deeply creased and has a row of spines near each margin. They possess great vitality and are often found among wheat and rye.

Many look upon Chess as degenerated wheat, because it appears among fall wheat that has been winter-killed. This idea is erroneous and without foundation. The fact is that Chess will mature seed under adverse conditions, even though the plant be only a few inches high.

Time of flowering, June.

Time of seeding, July.

*Farm Weeds of Canada.



Fig. 3. Chess (*Bromus secalinus*).

"Chess is a typical plant belonging to the genus *Bromus*. Wheat belongs to the genus *Triticum*. Chess will produce Chess and only Chess, and a seed of wheat cannot be sown to produce Chess, and Chess cannot produce wheat under the most favourable conditions of growth.

"In instances where parts of a plant, apparently a combination of Chess and wheat, were so united as to seem but one plant, close examination proved them to be parts of separate plants, and that the apparent union was not real."

Control. Avoid sowing Chess in seed grain. The seed is comparatively short-lived, and a four-years' rotation exclusive of winter grain will clean it out of the soil. Patches in grain fields should be cut down before the plants mature their seeds. Thick seeding with early red clover is recommended for badly infested fields. The first crop of hay should be cut before the Chess has had an opportunity to produce seeds.

If a field is badly infested with Chess, plow the land two or three inches deep as soon as possible after the grain crop has been removed. Then work it up fine with the use of the roller and the harrow to conserve the moisture so that a large percentage of the Chess will be encouraged to germinate. In two or three weeks cultivate with a spring-toothed cultivator and harrow well. Continue to cultivate or disc the land frequently until the late fall, when it should be plowed deeply in order to bring the lower section of the soil to the surface.

Early in the spring thoroughly stir the surface soil with the cultivator and harrow. In about two weeks cultivate or disc and sow barley or other spring grain, seeding down with red clover or alfalfa.

If it is desired, fall wheat may be sown instead of the spring grain. In that case the land should be summer fallowed until time to sow the wheat. The summer fallow must be well cultivated and kept clean, and the wheat should not be sown until the middle of September.

Wild Oat (*Avena fatua*, L.)—Fig. 4

An annual weed with erect and smooth stems. The leaves and stems are covered with white bloom, which give a peculiar white-green colour to the whole plant. The head forms a loose panicle, with nodding and spreading branchlets. The awn is long and bent. It is bent most when dry, but if moistened it uncoils and wriggles around, thus causing the seed to move appreciable distances.

The principal points of difference between the Wild and cultivated Oats are: (1) in the former the chaff is thick and hairy, while in the latter it is thin and hairless; (2) the Wild Oat has a long, stiff awn which is bent and twisted when dry, while the cultivated oat either has a much smaller and less stiff awn or none at all; (3) the Wild Oat has a sucker-mouth scar at the base which is not present on a cultivated oat.

Time of flowering, July.

Time of seeding, July to August.

Dispersal: Conveyed from place to place by threshing machines, and as an impurity in seed grain.

Wild Oats are at home in any soil that will grow cereals, and they ripen their seeds among almost any cereal crop. The seeds possess wonderful vitality, some of them remaining buried in the soil for years and germinating as soon as they are brought under favourable conditions.

Control. On a field infested with Wild Oats, cereal crops should be dropped out of the rotation as far as possible; and hoed crops, soiling crops, hay and pasture should take their place. To get the land under grass, it should be fallowed during part of the season, the cultivation being frequent and shallow to destroy all seeds that may have germinated in the upper layer of the soil. The land can then be sown with winter wheat and seeded, or with an early variety of barley, which should be cut on the green side. The treatment mentioned is suitable for pasture land or land which has produced a hay or soiling crop during the fore part of the season.

Two hoed crops in succession may not be considered good farming practice, but can be used to great advantage in ridding badly infested fields of Wild Oats. Plow the ground early in the spring, or, if it has been plowed the previous fall, cultivate well and harrow the soil down fine in order to germinate the oats. When they have got well started disc or cultivate a second time. About the last week in May or the first of June, apply a good coating of manure and plant corn in hills so that it can be cultivated both ways. Keep the corn well cultivated and hoe out any oats that may come up in the hills. When the crop is harvested plow seven or eight inches deep.



Fig. 4. Wild Oats (*Avena fatua*).

The next spring repeat the early cultivation until it is time to plant another crop of corn, potatoes, rape or turnips. If this second cultivated crop is well looked after and kept clean, nearly all the Wild Oat seeds will be germinated and destroyed. Follow this hoed crop with an early variety of barley, seeding down to red clover or alfalfa, and you will have a good chance to get rid of any Wild Oats that remain.

**Couch-grass, Twitch-grass, Quack-grass, or Quick-grass;
also Wheat-grass (*Agropyron repens*, L., Beauv.)—Fig. 5**

Couch-grass is a creeping perennial from Europe. It has wide-spreading but shallow root-stocks which are jointed, fleshy, and form large matted beds. The flower stems are from one to three feet high, with three to seven flowered spikelets which are in two rows flat against the stalk on each side, forming a narrow spike three to eight inches long. The leaves are dark green, distinctly ribbed, often slightly soft hairy on the upper surface.

The seed is straw-coloured or dirty gray, one-half to three-eighths of an inch long, narrowly boat-shaped with the hull on, very narrowly wheat-shaped with the hull

off, surface indistinctly nerved lengthwise on the rounded face, sometimes with a short awn.

Time of flowering, June to July.

Time of seeding, July to August.

Dispersal: The root-stocks are carried around by implements, and the seeds are dispersed in seed grain, the coarser grass seeds, straw and manure.

Couch-grass may have some value for pasture, but its habit of taking and keeping possession of the soil renders it extremely objectionable. It flourishes best in loamy or humus soils from which it is especially difficult to eradicate. It propagates chiefly by creeping, underground root-stocks which are near the surface of the ground. When these root-stocks are broken by plowing before cultivation, each piece with a joint is capable of forming a new plant. Care therefore should be taken not to drag these pieces from one field to another on implement teeth.

Control. The control of Couch-grass requires frequent plowing and thorough cultivation with a spring-tooth harrow or cultivator, and the growing of hoed crops or smother crops. In fighting Couch-grass, it is not generally wise to use a disc as this implement cuts the underground root-stocks into short lengths, each of which may produce a new plant. The following are the methods which have been found most satisfactory in the control of this pest:

Methods of cultivation for the destruction of Couch-grass: If the field in which the Couch-grass is troublesome is in meadow or pasture, first let the plant exhaust its substance by producing a hay crop, which should be cut and removed as soon as the heads are formed and **before they are in bloom**. Then plow the field about three inches deep and work the land at intervals of one week with a spring-toothed cultivator for the remainder of the season so as to bring the Couch-grass "roots" to the surface. In the late fall plow the roots down. This after-harvest cultivation will do much to eradicate Couch-grass; but to make the job complete the cultivation with the spring-toothed cultivator should be continued the next spring until it is time to sow a hoed crop or a smother crop.

The use of rape in the destruction of Couch-grass: Cultivate the field until about the middle of June, running over it frequently with the cultivator so as to keep the tops down and thus weaken the "roots." Then apply manure at the rate of about twenty tons per acre (twelve good loads). Cultivate the manure in thoroughly and, with a double mould board plow, slightly ridge up the land, making the ridges about 26 inches apart. On the ridges sow pasture rape at the rate of $1\frac{1}{2}$ pounds per acre. It is important that the right amount of rape should be sown, for if too little is sown the stand will not be thick enough to smother the Couch-grass, and on the other hand, if too much is sown, the plants will be too crowded and not grow vigorously enough to keep ahead of the weed. Sow the rape when the land is sufficiently moist to insure quick germination of the seed. If the rape is slow in starting, the Couch-grass may get a start in the rows and thus necessitate hand cultivation there. Cultivate the rape every week or ten days until it occupies all the ground and makes further cultivation impossible. If, when the rape is cut or pastured, any Couch-grass remains the field should be ridged up the last thing in the fall and a hoed crop put in the following year. This should not be necessary if a good stand of rape is secured.

Corn and buckwheat for the suppression of Couch-grass: It is claimed that corn grown for two years in succession will completely eradicate Couch-grass. This necessitates the Couch-grass being kept down by cultivating and frequently hoeing the hills to kill any Couch-grass that may get started in them. Many men report good success in eradicating Couch-grass by growing buckwheat for two years in succession. The advantage in favour of buckwheat for this purpose is that no cultivation or hoeing is required while the buckwheat is growing. It is essential, however, that the Couch-



Fig. 5. Couch-grass on right of figure and part of a stalk of perennial Rye-grass (*Lolium perenne*) on left. Note the arrangement of spikelets in the Rye-grass.

grass be kept down by repeated cultivation before the buckwheat is seeded and after it is harvested. Fall plowing, followed by thorough cultivation until frost and seeding with buckwheat as early as possible in the spring, then plowing the first crop of buckwheat down about July 1st and sowing another crop of buckwheat, is another method which has proved fairly satisfactory.

A bare summer fallow for one entire season will eradicate Couch-grass, except in very wet years, but, on account of the cost of cultivation and the loss of the year's crop, it is seldom advisable to employ this method.



Fig. 6. Skunk-tail Grass (*Hordeum jubatum*).

Skunk-tail Grass, Wild Barley, or Squirrel-tail Grass
(*Hordeum jubatum*, L.)—Fig. 6

This grass is very troublesome in the West, and is now quite frequently found in many parts of Ontario, especially along railways.

A native perennial grass forming tufts from 8 to 12 inches high. Leaves are pale green in colour, from 3 to 4 inches long, with rough margins. Flowers are in a silky, bristly spike, from 3 to 4 inches long, pale yellowish green in colour. The seed is slender, sharp-pointed, somewhat resembling a small barley seed, and has a long, upwardly barbed awn. (Fig. 6.)

Control. Cut the plants whenever they appear in waste places, and thus prevent them from going to seed and spreading. This weed is not troublesome in fields under cultivated crop. Cut patches of it in meadows just as soon as it ears out. This will not injure the other grasses in the meadow.

Old Witch Grass, or Tumble Grass (*Panicum capillare*, L.)

An annual grass, very common in neglected hoed crops, gardens and waste places. Plants stout, with hairy leaves and large, finely branching, loosely spreading tops (panicles), which are often seen rolling over the ground on windy days in the fall of the year.

Barnyard Grass, or Cockspur Grass (*Echinochloa crusgalli*, L., Beauv.)

This grass is often abundant in hoed crops, headlands and waste places. The seed occurs occasionally in commercial seeds. A coarse annual grass from 1 to 3 feet high with broad leaves. Inflorescence 1 to 3 inches long, consisting of several one-sided branches crowded together and bearing numerous short-awned spikelets. Seeds dark green to brown, flat on one side, round on the other, $\frac{1}{8}$ of an inch long, very smooth and shining.

Control. Proper cultivation of hoed crops and taking care to cut in waste places before it seeds will cause it to disappear.

Finger Grass, or Crab Grass (*Digitaria sanguinalis*, L., Scop.)

A troublesome grass in lawns and sometimes in low fields. A much-branched, leafy annual, from 10 inches to 2 feet high, spreading on the ground and frequently rooting at the lower joints of the stem. The leaves are from 2 to 4 inches long, with rough margins. Flowers are produced in spikes which come off from the stem like the fingers on the hand, hence the common name, Finger Grass.

Control. A much harder grass to eradicate than the Foxtails, because it roots so readily at the joints. Repeated cultivation after harvest will do much to destroy it. Spud out patches in lawns and stir the soil with a rake and sow heavily with pure lawn grass seed when the ground is moist.

THE NETTLE FAMILY (URTICACEAE)

Hemp, or Marijuana (*Cannabis sativa*, L.)—Fig. 7

This plant is included in this bulletin not because it is a weed in agricultural crops, but because from it are manufactured Marijuana cigarettes, which are habit-forming and produce such disastrous effects in those who smoke them. In order to protect the youth of this country, the government has now prohibited the growing of this plant and is endeavouring to exterminate it from Ontario. In the past, Hemp has been cultivated to some extent in Ontario and is now found growing wild in many parts of the Province. It is seen in neglected fields, pastures, barnyards, waste places and along roadsides. It grows very luxuriantly on low, rich ground.

Description. Hemp is an annual, reproducing only by seed. The plants have coarse, branching stems 3 to 10 feet high. The leaves are compound, with 5 to 7 narrow, lance-shaped, rough-margined leaflets. The plants are dioecious. Some plants produce flowers with stamens only, while other plants produce flowers with pistils only. All of the flowers are green and inconspicuous. The flowers with stamens are produced in narrow clusters (racemes), and those with pistils are produced in the axils of the leaves. The growing plant has a very rank odour. The seeds are broadly oval, slightly flattened, grayish brown, often mottled with darker brown, and about $\frac{1}{5}$ of an inch in length.

Control. Hemp will not persist in a well-cultivated field. It can be eradicated from waste places or pastures by mowing or cutting before seed is formed.



Fig. 7. Hemp (*Cannabis sativa*).

THE BUCKWHEAT FAMILY (POLYGONACEAE)

Dock, Curled Dock, Sour Dock, or Yellow Dock (*Rumex crispus*, L.)—Fig. 8

A deep-rooted perennial weed introduced from Europe.

It occurs around buildings, in neglected lanes, along waysides and in pastures. The stem is quite slender, and the leaves are from 6 to 12 inches long, with wavy margins; hence the common name, "curled dock." The flowers are in racemes, green in colour. The seed is covered by a winged husk and is carried considerable distances by the wind. The manner of attachment of the seed to the wing is shown in illustration (Fig. 8). The seeds are light brown in colour and beech-nut shaped. They are smooth and shiny.

The wind acts as an agency in scattering the seed, and it is a very common impurity in clover and other seeds used on the farm.

An average plant produces about 17,000 seeds.

Time of flowering and seeding, July to August.

Control. Sow pure seed only. Put the land under a short rotation of crops, which allows for the frequent introduction of hoed crops. The later-sown hoed crops such as rape are more effective than those sown earlier in the season. Keep the land clean by frequent cultivation until it is time to put in the hoed crop. In meadows or pastures pull the Dock when the soil is soft after rain. Pull or cut before seeding any Docks that may be seen in the clover seed crop. In lawns or pastures, when the ground is too hard and dry to permit pulling the Dock, cut them off below the ground and apply a heavy coating of coarse salt.

Sorrel, or Sheep Sorrel (*Rumex acetosella*, L.)—Fig. 9

A perennial with running root-stocks. The stem is slender and erect, with branches. The leaves are spear-shaped and quite characteristic. The flowers occur in racemes and are green to greenish red in colour. The foliage has a pronounced acid taste.

The seed is 1/16 of an inch long, triangular, smooth and shining when naked, but dull brown when invested by its covering. An average plant produces about 10,000 seeds.

Time of flowering, June to September.

Time of seeding, July to October.

Propagation: By its running root-stocks, and as an impurity in clover seed, especially alsike.

Control. Sorrel is usually an indication of a poor, sandy or gravelly soil. It prefers acid soils, hence liming and manuring are effective remedies when the land is well-tilled. The remedies given for the Dock (Fig. 8) are applicable to Sorrel, only it requires more frequent use of the broad-share cultivator, which should be used so as to cut the roots just below the surface of the soil, without bringing up any of the creeping root-stocks.

Lady's Thumb, or Smartweed (*Polygonum persicaria*, L.)

This plant grows to a height of 12 to 18 inches. Its leaves are lance-shaped, usually with a dark blotch near the centre. It is an annual and is often abundant.

Control. Prevent from seeding, and sow clean seeds.

Wild Buckwheat, or Black Bindweed (*Polygonum convolvulus*, L.)—Fig. 10

An introduced annual weed found commonly in cereal crops throughout Ontario. It is a twining herb with branching stems and thin, smooth, arrow-shaped leaves; flowers small, inconspicuous, greenish in clusters in the axils of the leaves, and at the

end of the stems. Seeds black, often covered with a brownish "husk," buckwheat-shaped, about $\frac{1}{8}$ of an inch long, but when found in grain the outer black hull is often missing, and the seed is then white and waxy in appearance.



Fig. 8. Curled Dock (*Rumex crispus*).

Time of flowering, June to September; seeds ripen about the middle of July.
Dispersal: By seeds.



Fig. 9. Sheep Sorrel (*Rumex acetosella*).

Control. Watch for the seeds of Wild Buckwheat in your seed grain. Cultivate lightly immediately after harvest and cause the seeds to germinate, then harrow out the young plants. Harrow grain crops lightly when the grain is about 3 inches high.



Fig. 10. Wild Buckwheat (*Polygonum convolvulus*).

THE SPINACH OR GOOSEFOOT FAMILY (CHENOPODIACEAE)

Lamb's Quarters, or Goosefoot (*Chenopodium album*, L.)—Fig. 11

An annual weed widely distributed in cultivated land. It grows to a height of from 2 to 6 feet. The stem is grooved and much branched. The leaves are whitish green below and dark green above. The flowers are inconspicuous and greenish in colour.

The seed (Fig. 11) is black and shining, lens-shaped and round, about $\frac{1}{16}$ of an inch in diameter.

Time of flowering, June to October.

Time of seeding, August to October.

Distribution: By seeds, especially as an impurity in clover and grass seeds.



Fig. 11. Lamb's Quarters (*Chenopodium album*).

Control. Late cultivation is especially necessary in combating this weed, as it flowers and seeds till very late in the season. The land should be gang-plowed shallow and harrowed immediately after the harvest, and cultivated at intervals until late in the fall, when it may be plowed or ribbed up for a hoed crop the following spring. Subsequent treatment the same as for Foxtail (Fig. 2).

OAK-LEAVED GOOSEFOOT. Usually spreads on the ground. Its leaves are like minute white oak leaves

MAPLE-LEAVED GOOSEFOOT. Grows erect, with large, thin, triangular leaves.

STRAWBERRY BLITE. Resembles the last, but has red seed clusters.

SPREADING ORACHE. Somewhat resembles Lamb's Quarters, but has larger and thicker leaves, goosefoot-shaped. It is much branched or spreading, and the seed covers are warty.

Russian Thistle (*Salsola kali*, var. *tenuifolia*, G. F. W. Mey)—Fig. 12

This is a weed which has appeared on many farms in Ontario, but does not appear to have become established in cultivated fields. It has been introduced as an impurity in alfalfa seed. The Russian Thistle is a very serious pest in several of the Western States, and is found in the Prairie Provinces, but has not yet been reported as being very troublesome there. The plants, when ripe, break off at the surface of the ground and are rolled long distances by the wind, scattering their numerous seeds on their journey. It is this tumbling habit that makes this weed particularly adapted to the prairie lands of the West, and it probably will never be a serious pest in Ontario, where fences, trees and other obstructions will prevent its being spread far and wide by the wind.



Fig. 12. Russian Thistle.

Description. The Russian Thistle is a native of Europe and Western Asia. It is a nearly-smooth, bushy-branched annual, from 1 to 3 feet high. Mature plants are more or less spherical in form. The stems and branches are red in colour. The leaves are awl-shaped, 1 to 2 inches long, soft and fleshy when young, very prickly pointed

when mature. The flowers are inconspicuous, being small, without petals, and solitary in the axils of the leaves. The seeds are about $1/12$ of an inch long, obconical in general outline, with a cup-shaped depression at the upper end, in the centre of which is a pointed projection; colour dull gray or green; embryo spirally coiled.

Control. The Russian Thistle, being an annual weed, is not hard to exterminate. If once cut off at the surface of the ground it never grows again, and hence in well-cultivated fields it is not likely to prove a pest. The chief danger lies in neglect. A single plant produces an enormous number of seeds, and if a few specimens are allowed to mature they will seed down a whole field and cause serious trouble the following year,



Fig. 13. Pigweed (*Amaranthus retroflexus*).

especially in a crop which does not allow the frequent use of the cultivator. Farmers in Ontario should, therefore, be on the lookout for this weed and destroy any specimens they may find in their fields, fence corners, or along the roadsides.

THE PIGWEED FAMILY (AMARANTHACEAE)

Pigweed, or Redroot (*Amaranthus retroflexus*, L.)—Fig. 13

An annual, with a pink root, stout, erect stem and many branches. It grows from 1 to 6 feet high. The leaves are light green in colour and ovate in shape. The flowers are in dense spikes which terminate in branches or are from the axils of the leaves. They are inconspicuous, green in colour, and surrounded by chaff-like scales.

The seeds (Fig. 13) are egg-shaped, black, smooth and shiny. The average plant produces about 15,000 seeds.

Time of flowering, July to September.

Time of seeding, August to October.

Dispersal: The seed is distributed by the wind and as an impurity in grass seed.

Control. Special attention must be given to fall cultivation of the soil so as to prevent plants from ripening, and to sprout and destroy the seeds which have fallen upon the ground. The land should be gang-plowed shallow and harrowed immediately after harvest, and cultivated at intervals until late in the fall, when it may be plowed or ribbed up for a hoed crop the following spring. Subsequent treatment the same as for Foxtail (Fig. 2).

TUMBLE WEED, OR WHITE PIGWEED (*Amaranthus graecizans*, L.). This plant resembles Russian Thistle quite closely, but can be distinguished from it by its round, shiny, jet black seeds, and by its leaves, which, although small, have a definite blade. It is a low-branched annual when growing in sandy, open fields and roadsides.

Control. Prevent the maturing of the seeds, which ripen in August. The plants as a rule are conspicuous, and may be readily collected and *burned*. The seeds are often found in grass seed mixtures.

SPREADING AMARANTH (*Amaranthus blitoides*, Wats.) forms large mats on waste ground, along roadsides and walks.

THE PINK FAMILY (CARYOPHYLLACEAE)

Corn Spurrey (*Spergula arvensis*, L.)—Fig. 14

This is an annual weed introduced from Europe. It is found chiefly on sandy soil. It grows from 15 to 18 inches high. The flowers are small, white, and in loose terminal clusters. The leaves are needle-like in whorls at the joints of the stem. The seeds are dull black, mottled with brown, round and flattened, with the margin extending into a narrow rim.

Time of flowering, July; seeds ripen, July to August.

Dispersal: By seeds.

Control. Spurrey does not give serious trouble when a systematic rotation of crops is followed. Early after-harvest cultivation will do much to rid the land of Spurrey. Seedling plants in spring grain can be destroyed by application of the weeder or harrow.

Corn Cockle, or Purple Cockle (*Agrostemma githago*, L.)—Fig. 15

An annual introduced from Europe, about 1 to 3 feet high, with erect habit of growth. It has but few branches, and the stems are all very hairy, with whitish green

hairs. The leaves are rather long and narrow, with pointed ends. The flowers are red to purple, and the flower cup, calyx, has long lobes, three or four times the length of the petals.

The seed capsules are generally well filled with seed, which is black in colour and irregularly kidney-shaped, with tubercles (small conical projections) arranged in rows around the sides of the seed. (See Fig. 15.) The seed is about $\frac{1}{8}$ of an inch across. An average plant produces about 500 seeds.

Time of flowering, July.

Time of seeding, August.

Dispersal: By birds, in manure, and as an impurity in seed.



Fig. 14. Corn Spurrey (*Spergula arvensis*).

It may be noted in passing that the seed is injurious to young chickens, and the husks of the seed often elude the miller and appear as black specks in flour, which is seriously damaged thereby. An old writer, Gerarde, says:

“What hurt it doth among corn (wheat), the spoyle unto bread, as well in colour, taste, and unwholsomeness, is better known than desired.”

Control. Sow clean seed; and when the weed is not very thick pull it by hand. Practice a short rotation of crops. Cultivate thoroughly after harvest. If this weed is very abundant fall wheat should be omitted from the rotation for four years.



Fig. 15. Corn Cockle (*Agrostemma githago*).

BLADDER CAMPION

SILENE LATIFOLIA

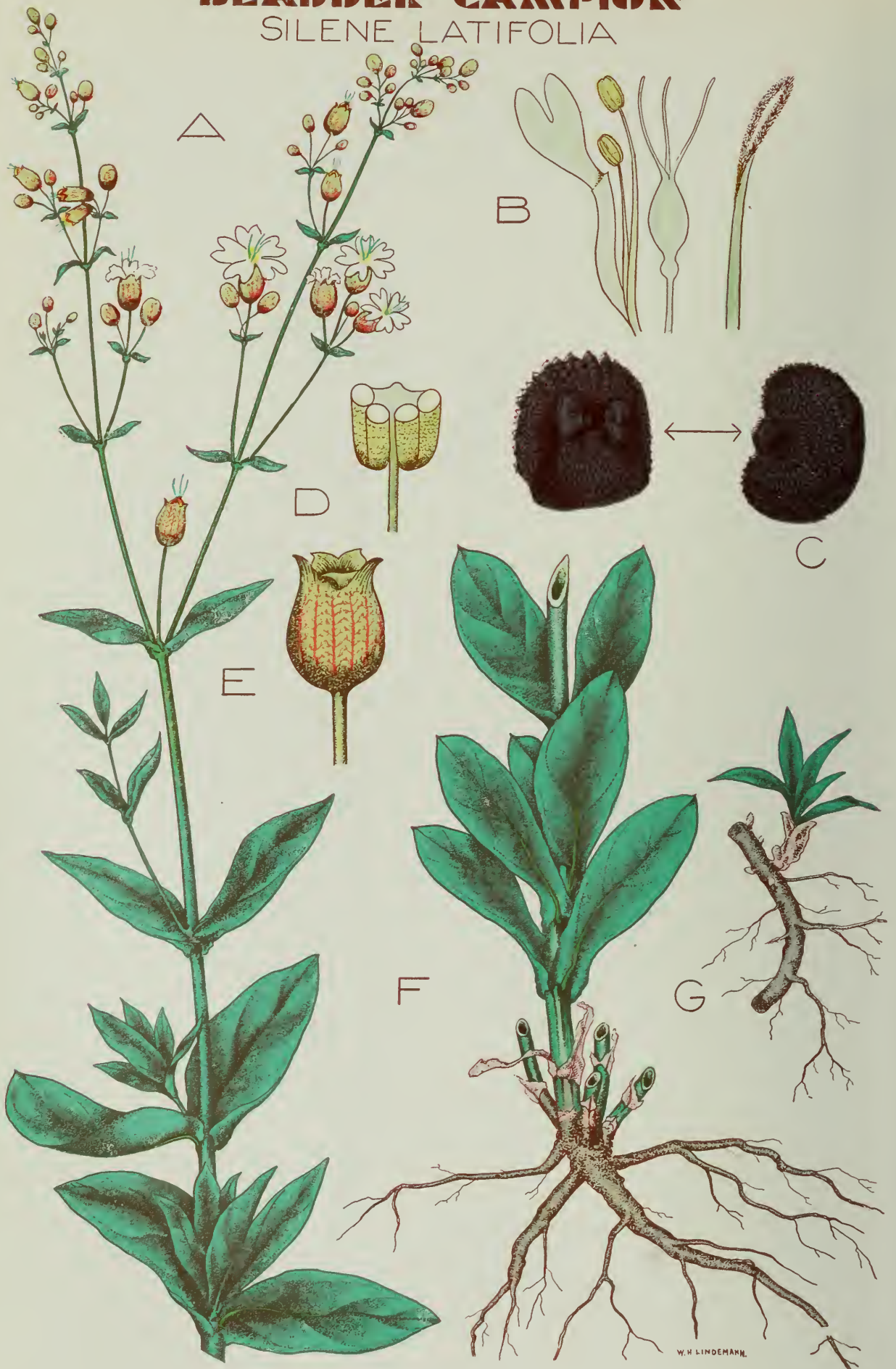


Plate 1.

Bladder Campion, Cow Bell, or Bladder Weed (*Silene latifolia*, Mill, Britten & Rendle)

This is one of the worst weeds in the Province of Ontario. It is found in every part of Ontario, but is especially prevalent in the central and eastern sections of the Province. It is seen usually on high land. Once established on a farm it is an extremely difficult weed to eradicate, especially from land inclined to be stony. It produces large quantities of seed, and the seed is one of the most common impurities in clover, especially red clover. It is impossible to remove the seed from clover and timothy seed with ordinary cleaning mills. Bladder Campion is listed as a primary noxious weed under the regulations of The Canada Seeds Act, and classified as a noxious weed under the provisions of The Ontario Weed Control Act.

Description. Bladder Campion is a deeply rooted, freely branching, persistent, perennial weed. The root is very long, thick, and much branched. A good-sized plant will have a root over 3 feet long, at the top of which is a crown bearing buds, shoots and branched flowering stems. It grows from 1 to 2 feet high, often forming large clumps. The leaves are ovate, lanceolate, smooth, in pairs, with their bases meeting around the stem. Their flowers are white, nearly an inch across, and borne in loose clusters which are often dropping. The petals are two-cleft, and the calyx or flower cup much inflated and bell-shaped, with distinct purplish veins. It is from the inflated calyx that the plant derives its common names, Bladder Campion, Bladder Weed and Cow Bell. The capsule or "seed pod" is enclosed by the inflated calyx and opens at the top by three to six recurved teeth. The seeds are light brown to dark gray in colour, irregularly kidney-shaped, about 1/16 of an inch in length, and the surface is covered with regularly arranged rows of pointed tubercles. Typical seeds show a marked depression at the scar. This character and the more pointed tubercles make it possible for a careful observer to distinguish them from the seeds of Night Flowering Catchfly and White Cockle which they resemble very closely.

Time of flowering, June to August.

Time of seeding, July to October.

Dispersal: The seed is distributed as an impurity in grass and clover seeds, especially in red clover. The plant is spread also by portions of the crown being dragged over the field by implements, as any part of the crown which has buds, if covered with soil, is capable of growing and forming a new plant.

Control. Pure seed is of primary importance to prevent the introduction of this weed onto the farm. Sow only seed that has been tested for purity and certified free from the seeds of this pernicious pest. Clover seed should not be produced on land polluted with Bladder Campion.

If only a few small patches of Bladder Campion are found in a field, prompt measures should be taken, or it will spread over the whole farm. These small patches should be carefully dug out early enough to prevent the weed from seeding. Great care must be taken to get every piece of the root and crown. As the roots are very deep, digging out these stray plants requires some labour, but nothing like the labour involved in cleaning a badly infested field. It is claimed that small patches of Bladder Campion can be destroyed by spraying with a chemical weed killer containing sodium chlorate.

If a field is badly infested with this pest, much time and labour will be required in order to clean it. This is clear when we realize that Bladder Campion is a very deep-rooted, free-seeding perennial with a branching crown bearing numerous buds. Some system of cultivation and crop rotation must be used that will provide for the frequent use of the plow to destroy the roots and crowns and plenty of cultivation to germinate the seeds and destroy the seedlings.

In dealing with a meadow badly infested with Bladder Campion, cut the hay early so as to prevent the weed from going to seed and to allow for cultivation being given during the hottest part of the summer. Immediately after the hay is cut, plow the field sufficiently deep to be well under the crown of the Bladder Campion plants. Then cultivate deeply with a broad-share cultivator, or with a narrow-pointed, curved-toothed cultivator. Many men claim that this latter type of cultivator gives the better results, as it cuts more of the remaining roots and brings more of crowns and roots to the surface of the ground than does a straight-toothed cultivator. This is a great advantage in hot weather. Whatever type of cultivator is used, the cultivation should be continued for the balance of the season so as to keep the field in black fallow until the ground freezes up. The next spring start cultivation as early as possible in order to start the Bladder Campion seeds germinating. Give repeated cultivation to destroy successive crops of seedlings, then sow roots or corn.

Many farmers have found by experience that fields badly infested with Bladder Campion can be cleaned by deep plowing immediately after harvest, followed by thorough cultivation and cross-cultivation with a broad-share cultivator; this deep cultivation continued the following spring at intervals of about two weeks, keeping the land perfectly bare until time to plant corn, which is sown in hills and cultivated both ways throughout the summer months.

A short rotation of crops is necessary to keep this weed under control. It should provide for deep and thorough cultivation in the spring before seeding and again as soon as the crop is removed.

On uncultivated lands, sheep will be found a great help in keeping this weed from seeding and spreading to clean fields.

White Cockle, Evening Lychnis, or White Campion (*Lychnis alba*, Mill.)—Fig. 17

This is a biennial or short-lived perennial weed introduced from Europe. It is a very hard weed to get rid of once it becomes established on a farm. It is much more troublesome than Night Flowering Catchfly. The roots of mature plants are large and fleshy, the stems branching, from 1 to 3 feet high. The leaves are ovate, lanceolate with acute tips. The whole plant is hairy and sometimes slightly sticky. The flowers are in a loose cluster, white or pink in colour and about $\frac{3}{4}$ of an inch across. They are dioecious, that is, all the flowers on some plants have stamens only, while all the flowers on other plants have pistils only. The seed pod when mature has ten little teeth at the top.

Time of flowering, June to August.

Time of seeding, July to September.

Dispersal: By wind and as an impurity in seeds.

Control. A persistent weed that is difficult to eradicate. Exercise great care in the cleaning of seed grain and examine all purchased grain and clover for the seed of this weed. A bare summer fallow with thorough cultivation will do much to suppress it. The roots are fleshy and hard to kill unless dragged right up to the surface of the soil. If there is a little earth covering any part of them they will continue to grow and produce seed. When spudded below the surface they will grow again, but do not produce seed that season. A short rotation of crops will keep it in check. Discing bare stubble will help to prevent it from seeding late in the season. Thick seeding with clover will restrict it by smothering. Pastures, following a single cut of early clover, should be trimmed with a mower about the middle of August to prevent the maturing of the seed.



Fig. 17. White Cockle (*Lychnis alba*).

Night Flowering Catchfly, or Sticky Cockle (*Silene noctiflora*, L.)

This is an annual or winter annual which resembles somewhat closely White Cockle. It can be distinguished from White Cockle by the smaller roots, by the sticky feel of the young plants due to the abundant glandular hairs, by the flowers which contain both stamens and pistils, and by the seed pod which has six teeth at the top.

Time of flowering, June to frost.

Time of seeding, July to frost.

Dispersal: As an impurity in clover and grass seeds.

Control. Be sure that all grass and clover seed sown is free from the seeds of this weed. Adopt a short rotation of crops. Hand pull from alsike fields before cutting the seed crop. If an alsike field is so badly overrun with this weed as to make hand pulling impracticable, cut it early for hay and rake it up and put under cultivated crop for a year or two.

Cow Cockle, or Cow Herb (*Saponaria vaccaria*, L.)

A weed common in grain fields in the West. The seed is often found in grain from the West. During the past few years it has been found in many parts of Ontario, but has not yet become a serious pest in this Province. It is a smooth, glaucous, annual plant, from 1 to 2 feet high. The leaves are oval, lance-shaped, opposite, and clasp the stem at the base. Flowers are bright pink, about $\frac{1}{2}$ of an inch in diameter. Seed pod is enclosed in the inflated, five-angled calyx, and contains about 20 black, spherical seeds about $\frac{1}{12}$ of an inch in diameter, with the surface minutely pitted.

Time of flowering, July; seeds ripe in August.

Dispersal: By seeds only.

Control. The plant, being conspicuous, is easily hand pulled. Fall and spring cultivation will do much to clean badly infested fields.

THE PURSLANE FAMILY (PORTULACACEAE)

Purslane, or Pursley (*Portulaca oleracea*, L.)—Fig. 18

Purslane is pre-eminently a garden weed, and is easily recognized by its fleshy leaves and stem, which lie prostrate on the ground. It is an annual.

The stems are red, and the leaves wedge-shaped and clustered at the ends of branches. The flowers are bright yellow, about $\frac{1}{4}$ of an inch across, and open only during full sunlight for a few hours in the morning. The seeds (Fig. 18), in small capsules, are black, kidney-shaped and extremely small. An average plant produces 60,000 seeds.

Time of flowering, July to frost.

Time of seeding, August until frost.

Dispersal: By seeds.

Purslane has been used as hog feed in very dry seasons, but the cost of gathering it is too great.

Control. Careful hoeing and constant cultivation. The latter should be as early as possible. Plants which have been hoed out should be raked up and destroyed or they will mature the seeds.

THE BUTTERCUP FAMILY (RANUNCULACEAE)

Tall Buttercup, Tall Crowfoot, or Meadow Buttercup (*Ranunculus acris*, L.)—Fig. 19

A noxious weed in low meadows and pasture lands. It crowds out the grass, and cattle will not eat it on account of its hot-tasting, blistering juice. It is seldom troublesome on well-drained land under a short rotation of crops.

An introduced perennial weed with fibrous roots and an erect, somewhat hairy stem. The leaves are three-parted, with the divisions again three-cleft with deeply lobed segments. Flowers are produced from early in June until frost. They are bright yellow in colour and conspicuous. The dry, seed-like fruits are in globose heads.

Time of flowering, June to frost; seed ripe by July.

Dispersal: By seeds.



Fig. 18. Purslane (*Portulaca oleracea*).

Control. When possible the land should be well drained and brought under cultivation, and not seeded down again until the weed has disappeared. On pasture lands which cannot be cultivated the weed should be cut closely two or three times each year; once early in June and again in July or August. This treatment to be successful must be repeated for two or three years.

THE MUSTARD FAMILY (CRUCIFERAE)

Penny-cress, Bastard-cress, French Weed, Wild Garlic, or Stink-weed
(*Thlaspi arvense*, L.)—Fig. 20

A winter annual, introduced from Europe, and a very bad weed. It is very abundant in Manitoba, and is becoming rather common in Ontario. It grows as an erect plant, with a number of branches from the upper part. The leaves are numerous during the first of the season, and clasp the stem by ear-like lobes. The flowers are



Fig. 19. Tall Buttercup (*Ranunculus acris*).

white and small, with spreading flower stalks. The pods which succeed the flower are very characteristic. They are nearly orbicular, about half an inch broad, quite flat, with a broad wing all around, and notched at the top. Fig. 20 shows this peculiarity. Each pod produces about twelve seeds, which are dark brown to black and oval in shape, with curved lines. An average plant produces about 20,000 seeds.

The plant has a peculiar odour, resembling that of garlic, hence some of the common names. The seed has a very pungent taste. When eaten by milch cows it imparts a disagreeable flavour to the milk.



Fig. 20. Penny-cress (*Thlaspi arvense*).

Time of flowering, May to September.

Time of seeding, June to September.

Dispersal: Chiefly by the wind.

Control. Hand pull and burn when in small quantities. If the field is badly infested the following method of eradication is recommended: *"Run a disc or harrow over the stubble as soon as the crop is removed so as to start into growth the seeds near the surface. The following spring cultivate or harrow these plants down, and as soon

*Farm Weeds of Canada.

as a growth of fresh plants starts plow the land and harrow at once. This land may be sown late to a green feed crop or it may be kept under a clean fallow for the whole season if the land can be spared. The following spring any growth of weeds should be cultivated down before sowing the crop."

Plants with fully formed pods should never be plowed down, as the seeds will mature below the ground and maintain their vitality for considerable time.



Fig. 21. Common Pepper Grass (*Lepidium apetalum*).

Pepper Grass, or Tongue Grass (*Lepidium apetalum*, Willd.)—Fig. 21

A native annual which grows from 6 inches to 1½ feet high. The stem usually has many branches, and the lower leaves terminate in a large lobe (with small lateral ones), with edges slightly cut in along the margin. The upper leaves are tapering. The flowers are small and white, with slender, spreading flower stalks. The seed pods are round, with a very small wing at the top and a notch at the extremity. The end of a branch with seed pods is shown nearly natural size in Fig. 21.

The seeds are reddish brown, flat and oval in shape, and 1/12 of an inch long. The average plant produces about 18,000 seeds.

Time of flowering, June to August.

Time of seeding, July to September.

Dispersal: By birds and as an impurity in clover seeds.

Control. Be careful to prevent the plants from seeding, and do not plow them under half-ripe, as many of the seeds will germinate even though partially matured. Pull and burn where only a few plants exist, and when they are numerous use the method employed for the eradication of Mustard.

Field Peppergrass, or Cow Cress (*Lepidium campestre*, L., R. Br.)—Fig. 22

This weed has been widely distributed throughout the Province as an impurity in clover seed. It is now found in nearly all the clover-growing districts in Ontario, and is a decided detriment to clover seed production. Field Peppergrass is listed as a secondary noxious weed in the regulations of The Seeds Act.

Description. Field Peppergrass is an introduced biennial weed. It grows from 1 to 2 feet high and branches freely. The basal leaves are petioled, oblong and entire, stem leaves spear-shaped, entire or slightly toothed, clasping the stem by their arrow-shaped bases. The flowers are small, white or yellowish in colour. The seed pods are broadly ovate, boat-shaped, being rounded below and hollowed out above. They stand out stiffly from the stem on pedicels about their own length. The seeds are dark reddish brown in colour, about 1/12 of an inch long, somewhat egg-shaped, rounded or somewhat flattened, and the surface is granular and slightly scurfy.

Time of flowering, June to August.

Time of seeding, July to September.

Dispersal: Chiefly as an impurity in clover and grass seed.

Control. Be sure that all the clover and grass seed sown is free from the seeds of this weed. Small patches in clover fields should be hand pulled. If too abundant in clover fields to hand pull, cut the clover early enough to prevent the weed from seeding. Clover fields badly infested with this pest should be plowed up and put under hoed crop for one season.

Hoary Cress, Hoary Peppergrass, or Perennial Peppergrass (*Lepidium draba*, L.)

This is a perennial weed with creeping root-stocks which has been reported as appearing for the first time in various parts of the Province during the past few years. It has apparently been introduced into new localities as an impurity in clover seeds. It has proved a very serious weed in certain parts of Western Canada and the United States. It is reported as being a very persistent and rapid-spreading pest. It is considered such a serious weed that it has been listed as a prohibited noxious weed under the regulations of The Dominion Seeds Act. This means that no seeds of any kind can be legally sold if they contain even one seed of Hoary Cress. Ontario farmers, therefore, cannot take too much care to prevent its introduction onto their farms.

Description. Hoary Cress has numerous branched underground root-stocks which are sent out from the base of the plant in every direction, and each of which sends

out roots and a shoot every few inches. The stems which appear early in the spring are from 1 to 1½ feet high and profusely branched. The leaves are oblong or oval, the upper clasping the stem at the base, and are obscurely hoary on the surface. The flowers are small, creamy white, in more or less flat-topped clusters. They are succeeded by small, thick, heart-shaped pods with a conspicuous point (style) on the end (see Plate 2). The seeds are reddish brown, oval or egg-shaped in outline, somewhat flattened, about 1/12 of an inch in length, the surface with a longitudinal groove starting at the point of attachment and running about half the length of the seed.



Fig. 22. Field Pepper Grass or Cow Cress (*Lepidium campestre*).

PERENNIAL PEPPER GRASS

LÉPIDIUM DRABA.



Plate 2.

Control. No seeds, especially those of the clovers and grasses, should be sown unless they have been examined by an official seed analyst and certified free from the seeds of Hoary Cress. If this weed is found in small patches, it should be dug out early in the season to prevent it from seeding. Care must be taken to carefully remove all the underground root-stocks. If a field should become overrun with this weed, it would be advisable to plow it immediately after harvest and then give frequent cultivation with a broad-share cultivator until late in the fall. The following spring the cultivation should be continued at intervals until it is time to put in a hoed crop, such as roots or corn. Such a crop, if properly cared for, following good cultivation as described above, should clean a field of this pest.



Fig. 23. Shepherd's Purse (*Capsella bursa-pastoris*).

Shepherd's Purse (*Capsella bursa-pastoris*, L., Medic)—Fig. 23

A winter annual, naturalized from Europe, with a long, deep tap root. The root leaves are lobed and form a large rosette, which lies close to the ground, and in this state it passes the winter. The following spring a more or less branched stem arises, with arrow-shaped leaves thereon. The flowers are very small and white in colour, and are much less conspicuous than the seed vessels, which are triangular in shape, and are attached to the stalk or pedicel at the lower apex of the triangle. From the character of these pods the plant obtains its scientific and common name. The triangular pod is divided down the centre by a partition, forming two cells, each of which contains from 10 to 12 seeds (Fig. 23). In size the plant varies greatly from a few inches to 2 feet, depending on the soil and locality. But even a very diminutive plant produces many seeds. The seed is very small, light brown in colour, and oblong in shape (Fig. 23). An average plant produces over 50,000 seeds. Fig. 23 shows shape of seed, also the arrangement of seeds in the pod.

Time of flowering, early spring till the beginning of winter.

Time of seeding, early spring till the beginning of winter.

Dispersal: As an impurity in grass seed; also by birds, as the pods when ripe open and drop the seeds, which are eaten by birds, and often evacuated without digestion or injury.

Control. It easily succumbs to cultivation; and, as the plant spreads only by seed, persistent effort should be made to prevent seeding.

Small-seeded False Flax (*Camelina microcarpa*, Andrzej)—Fig. 24

This is an introduced annual and winter annual, very frequently seen in fall wheat and alsike clover. The stem is simple or branching; the lower leaves are long with a stem or petiole, and the upper ones clasp the stem with arrow-shaped bases. The flowers are numerous, pale yellow, and somewhat inconspicuous. The seed vessel or pod is somewhat pear-shaped, with a small projection from the upper end. The little stalks holding the seed pods are slender and spreading or ascending. The seed is reddish brown with minute whitish spot at the small end, somewhat oval in shape, about 1/20 of an inch in length, the surface very finely granular roughened and grooved lengthwise. An average plant produces about 40,000 seeds.

Time of flowering, June to August.

Time of seeding, July to October.

Dispersal: As an impurity in clover and grass seeds, especially alsike and timothy.

Control. This weed does not long give serious trouble where a short rotation of crops is practised and where thorough cultivation and seeding to grasses is done with spring grains instead of fall wheat. If the field is very badly overrun with this weed, proceed as follows: Plow lightly as soon as the crop is harvested; harrow and then cultivate frequently throughout the autumn to destroy the young seedlings. It is important that this autumn cultivation should be thorough. Put a hoed crop in the field the following year and give it good cultivation.

Common or Western False Flax (*Camelina sativa*, L., Crantz)

This is the common False Flax of Western Canada. It was probably introduced into this country as an impurity in imported flax seed. In Europe it is cultivated for the fine oil extracted from the seed, which is used in feeding cattle. It resembles the Small-seeded False Flax, but is coarser and has larger flowers, pods and seeds.

Control. The same as for the preceding species.



Fig. 24. Small-seeded False Flax (*Camelina microcarpa*).

Ball Mustard (*Neslia paniculata*, L., Desv.)—Fig. 25

A weed of European origin, common in grain fields in the Western Provinces, and now becoming frequent along railway lines and in waste places in Ontario.

A slender annual or winter annual from 2 to 3 feet high. Leaves oblong, pointed, and clasping the stem at the base. Flowers small, orange-yellow in colour, in long, slender terminal clusters (racemes). Pods round, veiny ridged and containing a single yellow seed. They do not split open, and are commonly taken for the seeds. They are frequently found in seed grain and screenings from the West.



Fig. 25. Ball Mustard (*Neslia paniculata*).

Control. Avoid sowing seed grain containing "seeds" of this weed. Hand pull and burn when in small quantities. Badly infested fields should be given thorough early after-harvest cultivation, followed by spring cultivation and a hoed crop next season.

Wild Radish (*Raphanus raphanistrum*, L.)—Fig. 26

This is a weed of European origin which is a serious pest in the Maritime Provinces, and which has recently been introduced into Ontario. It is an annual and winter annual; from 1 to 2 feet high. In general appearance it is like the Wild Mustard, but its yellow flowers have purplish veins in the petals and the pods are much more



Fig. 26. Wild Radish (*Raphanus raphanistrum*).

jointed in appearance. The seeds are $\frac{1}{10}$ of an inch long, light reddish brown, oval in outline, and with the surface finely roughened.

Time of flowering, June to September; seeds ripen by August.

Dispersal: By seeds.

Control. Hand pull when it first appears to prevent it from spreading. If it becomes very plentiful, follow the method of cropping outlined for Wild Mustard.



Fig. 27. Mustard (*Brassica arvensis*).

Wild Mustard, Charlock, or Herrick (*Brassica arvensis*, L., Ktze.)

Among the worst weeds in Ontario is the Wild Mustard, an annual, naturalized from Europe, with fibrous roots and erect habit of growth. The stem is rough with stiff hairs somewhat scattered over the surface. The branches arise from the upper part of the stem and bear oblong leaves, and the lower leaves have one terminal large lobe and several smaller lateral ones (lyre-shaped). The flowers are yellow, showy, and about $\frac{1}{3}$ of an inch broad, with stout flower stalks, which are more noticeable when the plant is in fruit. The pods, which appear on the lower part of the stem when the top is in flower, are from 1 to 2 inches long, and are either spreading or ascending.

The shape of the pod is characteristic; it is constricted between the seeds, thus giving the appearance of a rounded enlargement where each seed is borne. This appearance is termed "knotted." The pod terminates in a two-edged beak, and the two valves of the pod are strongly veined or ribbed. The seed (see Fig. 27) is black, $\frac{1}{16}$ of an inch in diameter, perfectly spherical, and very much like rape or turnip seed, and it retains its vitality for a long time when buried in the soil. An average plant produces 15,000 seeds.

Time of flowering, June to September.

Time of seeding, July to September.

Dispersal: By birds and implements, but chiefly as an impurity in seed.

Control. Owing to the great vitality of the seed, Mustard is a very hard weed to eradicate. The seeds, once in the ground, live for years, and continue to germinate as they are brought near the surface. Hence it takes patience, a great deal of labour and a long time to get rid of the weed when it once gets possession of the land. When present only in small amounts, hand pulling is the best method, providing the pulling is done before seeds have formed; and as persons pulling in a hurry cannot wait to examine for seed, it is best to put the weeds, as they are pulled, in bundles where they can be burned when dry.

When a field is overrun with Mustard, it is best to proceed as follows: Give thorough and repeated after-harvest cultivation to destroy successive crops of seedlings. Put in a hoed crop, either roots or corn, the following spring and cultivate it thoroughly throughout the growing season. Cultivate and harrow well two or three times after harvesting the crop, having first run the plow along each row of corn roots to cut the roots and turn them up. (If a plow is used after roots or corn it is likely to bring more Mustard seeds to the surface.) Sow a crop of grain the following spring and seed with clover. Pull the Mustard by hand out of the grain crop or, if this involves too much labour, prevent it from seeding by spraying or dusting as described below. Take a crop or two of hay or pasture, then break up the clover sod and give thorough cultivation before sowing grain again. When necessary at any stage in this method, use a grubber or a sub-soil plow to stir the soil to a greater depth than is reached by surface cultivation.

Sometimes it is advisable, when Mustard is very plentiful, to delay seeding to allow for more thorough cultivation before the crop is sown. Harrowing with a light harrow when the grain is two or three inches high has proven effective in destroying great numbers of young Mustard seedlings without injury to the grain.

DESTRUCTION OF MUSTARD BY CHEMICALS

Chemical sprays and dusts can be successfully employed to destroy Mustard. It is, however, usually advisable to use them in conjunction with methods of cultivation and cropping, the Mustard being sprayed or dusted each year the field is sown to grain.

Spraying with Copper Sulphate to Destroy Mustard in Cereal Crops

Copper sulphate or bluestone can be successfully employed for this purpose without causing permanent injury to standing grain or to fresh seedlings of clover.

A 3% solution should be applied at the rate of about 100 gals. per acre. A solution of the required strength can be prepared by dissolving $1\frac{1}{2}$ lbs. of bluestone in each 5 gals. of water or 30 lbs. in a 100-gallon tank.

Time to apply. Apply on a calm day just as soon as the first few plants in the field come into flower. *It is very important to spray early.* If the plants are left too long, the treatment is not nearly so effective. If a heavy rain comes within twenty-four hours after the solution is applied, it will be necessary to spray again.

How to apply the solution. An ordinary hand-pump barrel sprayer such as employed to spray fruit trees may be used, or a potato sprayer can be rigged up to do the work. Many of the up-to-date sprayers have a special broadcast attachment for spraying weeds. These are excellent for large areas, as they cover a wide strip at each round. Care must be taken to see that every Mustard plant is covered with the solution in the form of a fine spray.

Cyanamid Dust

Experiments and field demonstrations have shown that, if properly applied at the right time, Cyanamid dust will kill a very large percentage of the Mustard plants and at the same time increase the yield of the crop due to the fertilizing value of the dust. It can be employed to destroy Mustard in cereal crops without any permanent injury to the growing grain or new seedings of clover. Cyanamid dust prepared for the special purpose of killing weeds should be used.

Directions. Apply the Cyanamid dust evenly at the rate of from 100 to 125 lbs. per acre, when most of the Mustard plants have developed four leaves. Correct timing of the applications is essential to success, for if the dust is applied too early many of the very small plants will be missed, and if applied too late it will not kill the large plants. Cyanamid dust, to be effective, must be applied when the foliage is wet, preferably with dew. It is therefore advisable to dust in the late evening or early morning when there is a heavy dew on the foliage, or immediately after a shower of rain. Heavy rain the day the dust is applied may wash it off the plants before it has time to effect a kill. Dust, therefore, when fine weather is in prospect. An even application of the dust is necessary to ensure complete coverage of all the Mustard plants. There are a number of different types of dusters which can be used to apply Cyanamid dust evenly. Machines which use a wind blast for distribution are said to be the most satisfactory. The fertilizer attachment to a grain drill can be adapted to give fairly even distribution of the dust.

Sulphuric acid is used to kill Mustard in Western Canada, where it can be obtained cheaply and where special lead-lined sprayers are available.

Hare's-ear Mustard (*Conringia orientalis*, L., Dumort)—Fig. 28

A weed which is quite general throughout the West, in grain fields, on stubble and by roadsides; spreading rapidly. It has been found in one or two places in Ontario. An annual and winter annual with a straight, slightly branched stem from 1 to 3 feet high. Whole plant smooth and when young covered with a bloom like that of a cabbage. Leaves somewhat fleshy, oblong, oval, entire, and clasping the stem by two rounded lobes. They resemble in shape a hare's or rabbit's ear, hence the common name, Hare's-ear Mustard. Flowers are creamy white, about $\frac{1}{4}$ of an inch across. Pods are four-sided and 3 to 4 inches long. Seeds are dark reddish brown, $\frac{1}{12}$ of an inch long, somewhat wheat-shaped, with the surface granular roughened.

Time of flowering, July; seeds ripen in August and September.

Dispersal: By seeds.

Control. Hand pull small patches when the weed first makes its appearance. If a field becomes badly infested, try thorough, early, after-harvest cultivation.

Tumbling Mustard (*Sisymbrium altissimum*, L.)

This Mustard, which is troublesome in the West, is now found in many parts of Ontario, though it has not yet become a pest in cultivated fields in this Province. The fact, however, that it produces great quantities of seed indicates that if neglected it may become a serious nuisance. It is therefore advisable that a watch be kept for it in order that any plants which appear in cultivated fields may be destroyed before they mature their seeds.



Fig. 28. Hare's-ear Mustard (*Conringia orientalis*).

Tumbling Mustard is a bushy-branched annual or winter annual, from 2 to 5 feet high. The lower leaves are pinnatifid, with the segments pointing backward (runcinate); the upper leaves are very variable in size and outline, but are all deeply pinnatifid with narrow segments. The flowers are numerous at the end of the branches, pale yellow, and about $\frac{1}{3}$ of an inch in diameter. They are succeeded by long, slender pods, each of which contains numerous seeds. The plants, when mature, break off near the surface of the ground and are rolled about by the wind, scattering their seeds as they go. It is from this tumbling habit that the plant gets its name, Tumbling

Mustard. The seeds are very small, less than $\frac{1}{24}$ of an inch in length. They are greenish yellow to olive brown in colour and somewhat U-shaped. Being so very small they are not readily crushed by grinding, and thus frequently find their way unharmed into chop. It has been estimated that a single plant may produce a million and a half seeds, but fortunately they do not appear to have the vitality of the seeds of Field Mustard.

Time of flowering, June to September; seeds ripe in August.

Dispersal: By seeds.

Control. Pull stray plants along the roadsides and in waste places before they mature. Hand pull in fields unless very abundant. Badly infested fields may be cleaned by fall cultivation and harrowing over spring grain to destroy the seedlings.



Fig. 29. Green Tansy Mustard (*Sisymbrium incisum*).

Green Tansy Mustard (*Sisymbrium incisum*, Engelm., var. *filipes*, Gray)
Fig. 29

A common weed in grain fields in the West. In Ontario it is found chiefly along railways and in waste places. During the year 1910 it was reported as growing as a weed in cultivated fields from one county in Ontario. It is a biennial weed, and produces the first season a rosette of finely divided leaves which lie on the ground; the second season it produces a much-branched stem from 2 to 4 feet high. Leaves bright green, much divided into fine segments. Flowers bright yellow, $\frac{1}{8}$ of an inch across, borne in elongated clusters (racemes) and succeeded by narrow, smooth, slightly curved



Fig. 30. Worm-seed Mustard (*Erysimum cheiranthoides*).

Pods from $\frac{1}{2}$ to $\frac{3}{4}$ of an inch long, on slender, spreading stems. Seed is brownish red, about $\frac{1}{25}$ of an inch long, somewhat oblong in shape.

Time of flowering, July; seeds ripe in August.

Dispersal: By seeds.

Control. Hand pull. Thorough fall and spring cultivation will clean badly infested fields.

Wormseed Mustard, or Treacle Mustard (*Erysimum cheiranthoides*, L.)

Fig. 30

A native weed which seems to be spreading rapidly throughout the Province. Many specimens have been sent here for examination during the past years. An annual or winter annual, with erect and branching stems from 8 inches to 2 feet high. The foliage is bright green and abundant. The leaves are long, tapering at the base into a short petiole, and they are covered with T-shaped hairs. The flowers are yellow and about $\frac{1}{4}$ of an inch across. The little stalks (pedicels) holding the pods come out from the stem obliquely, but the pod stands erect on the pedicel, parallel with the stem. The pod is about an inch long and four-angled, with one row of seeds in each cell. The seeds are $\frac{1}{16}$ of an inch long and light brown in colour, with a furrow on one side. An average plant produces 25,000 seeds.

Seeds give a bitter taste to feed containing them.

Time of flowering, June to July.

Time of seeding, July to October.

Dispersal: Frequently as an impurity in clover seed.

Control. Hand pulling and burning is the best remedy when the weed occurs in small quantities, but where there is much of it the following procedure is advised: Harrow stubble ground early after harvest, or gang-plow and harrow. As soon as the seeds have had time to sprout, cultivate; repeat cultivation, and rib up the land with a double mould-board plow the last thing in the fall. Put in a hoed crop, either roots or corn, the following spring, and cultivate thoroughly throughout the growing season. Cultivate after the roots or corn, sow a crop of grain, and seed with clover. If not too numerous, pull weeds by hand out of the growing crop.

Yellow Rocket, or Winter Cress (*Barbarea vulgaris*, L.)

This is a weed which is often seen in early summer, especially in the low, damp parts of the field. It causes considerable alarm, as it is often mistaken for Mustard or Charlock. If observed closely, it is easily seen to be very different from Mustard or Charlock, which it resembles only in the colour of the flower. Yellow Rocket appears in new parts of the Province nearly every year. Its seed is apparently a common impurity in clover and alfalfa seeds. It is now listed as a secondary noxious weed in the regulations of The Seeds Act.

Description. This is a perennial weed which produces dense clusters of dark green, many-lobed leaves early in the spring, followed by upright, branching stems and clusters of yellow flowers from which develop slender pods (see Fig. 31). It is easily distinguished from Mustard by the dark green, smooth and shiny leaves, somewhat oval in outline. The lower leaves are petioled and much divided, the terminal division being much larger than the latter ones. The upper leaves are sessile and clasping. The seeds are dull grayish brown, oval in outline, $\frac{1}{20}$ of an inch long, the surface roughened.

Time of flowering, May to July.

Time of seeding, July to August.

Dispersal: Chiefly as an impurity in clover and grass seeds.

Control. If a field can be well drained and then plowed and given thorough fall and spring cultivation in preparation for the crop, this weed will not persist. Sheep will keep this weed from spreading in fields that cannot be broken up.



Fig. 31. Yellow Rocket or Cress (*Barbarea vulgaris*).

Rocket, or Rocket Salad (*Eruca sativa*, Lam.)

This is an European weed, the seed of which has been widely spread throughout Ontario as an impurity in alfalfa seed. It has been reported from many parts of the Province and has caused considerable alarm. It is not considered a very serious weed in Europe, but no chances should be taken with it in this country.

It is a hairy annual, somewhat resembling Wild Mustard. The leaves are more or less cut with a large terminal lobe. The flowers are yellowish white, and the petals have dark purple veins. The pods are shorter than those of Wild Mustard, with a

broad, flat beak. The seed is a light reddish brown, oval and plump in outline, a little larger than that of Wild Mustard. It is found chiefly in European alfalfa seed. Care should be taken to destroy stray specimens of this plant before it has an opportunity to go to seed. It is an annual, and if prevented from seeding it will soon disappear.

THE ROSE FAMILY (ROSACEAE)

Rough Cinquefoil (*Potentilla monspeliensis*, L.)—Fig. 32

A native annual weed found frequently in meadows and hay fields in some parts of Ontario. Stem erect, branching, rough-hairy. Leaves compound, with three some-



Fig. 32. Rough Cinquefoil (*Potentilla monspeliensis*).

what oblong, oval, toothed leaflets. Flowers bright yellow, in terminal clusters (cymes). The seeds are light brown, about $1/30$ of an inch long, blunt and slightly curved, with branching longitudinal veins on the surface.

Time of flowering, June to July; seeds ripe July to September.

Dispersal: By seeds, which are frequently found in timothy seed.

Control. This weed will not persist in cultivated crops. Repeated close cutting in hay fields, meadows and waste places will destroy it.



Fig. 33a. Silver Weed (*Potentilla anserina*).



Fig. 33b. Silver Cinquefoil (*Potentilla argentea*).

Upright or Rough-fruited Cinquefoil (*Potentilla recta*, L.)

A perennial weed with larger, paler, yellow flowers than the last, and 5 to 7 leaflets in each leaf. It is reported as being troublesome in meadows and hay fields in some parts of Ontario. Breaking up the field and putting it under a cultivated crop should clean out this weed.

Silver Weed (*Potentilla anserina*, L.)—Fig. 33a

This is a creeping perennial weed that is found in permanent pastures in many parts of Ontario.

Description. A tufted, herbaceous perennial, spreading by slender runners 1 to 3 feet long. It is easily recognized from its leaves, which are interruptedly pinnate, green above and white or silvery beneath. The flowers are yellow, somewhat like those of the buttercup. They are borne singly on long stems in the axils of the leaves. The seeds are brown, irregular in outline, about 1/10 of an inch long.

Silver Cinquefoil (*Potentilla argentea*, L.)—Fig. 33b

This is a closely related perennial weed of dry pastures which is frequently seen in Ontario. It is readily recognized from its digitately five foliate leaves, which are silvery white beneath. The flowers are yellow, a little smaller than the preceding species. The seeds are light brown, about 1/20 of an inch in length, somewhat comma-shaped, with indistinct lines on the surface.

Control. Pastures heavily infested with these weeds should be broken up and put under a short rotation of crops. Infested permanent pastures which cannot be plowed may often be improved by sowing a good permanent pasture mixture and by the judicious use of commercial fertilizers.

THE PEA FAMILY (LEGUMINOSAE)

Purple Tufted Vetch, or Perennial Vetch (*Vicia cracca*, L.)—Fig. 34

This is a persistent perennial weed which sometimes overruns old meadows. It, however, produces fodder of high food value, and is therefore often considered beneficial rather than detrimental in meadows. The plants are finely hairy, rarely smooth. The stems are tufted, weak, climbing or trailing, often 2 to 4 feet long. The flowers are bluish purple in dense, spike-like clusters of twenty or more. The leaves are compound, with ten or twelve pairs of leaflets. The seed is spherical, varying from 1/10 to 1/6 of an inch in diameter, velvety black or olive brown, mottled with white and black spots, and with a broad whitish scar about one-third or one-half the circumference.

Control. The methods which are used in controlling Canada Thistle and Perennial Sow Thistle are effective with this weed.

Wild Tare, Wild Pea, or Wild Vetch (*Vicia angustifolia*, L., Reich.)

This is an annual plant somewhat similar to Purple Tufted Vetch, but the flowers, instead of being in dense clusters, are borne singly or in pairs in the axils of the leaves. The seeds are very similar to those of the Purple Tufted Vetch, but can be distinguished from them by the narrower thread-like scar about one-fifth the circumference. They are very frequently found in grain. The plants are sometimes numerous and mat a crop by twining around the stems of the grain.

Control. Sow only clean seed grain. Gang-plow and harrow stubble ground early after harvest and pasture off or cultivate out the crop of tares that develops.



Fig. 34. Purple Tufted Vetch or Perennial Vetch (*Vicia cracca*).

Black Medick, or Yellow Trefoil (*Medicago lupulina*, L.)—Fig. 35

This is an annual weed of secondary importance which is often found in meadows, hay fields, and in lawns. It has considerable food value, and in Europe the seed is frequently sown with grass seed mixtures. It is often a nuisance in red clover and alsike fields. The seed is a frequent impurity in alsike and red clover seed. The plants are low and spreading, with trifoliate leaves somewhat similar to those of clover. The flowers are small, yellow in colour and clustered in little dense heads borne on stalks in the axils of the leaves. The pods are black, curved and conspicuously veiny ridged. Each one contains a single yellow seed with a minute nose-like projection on one side.

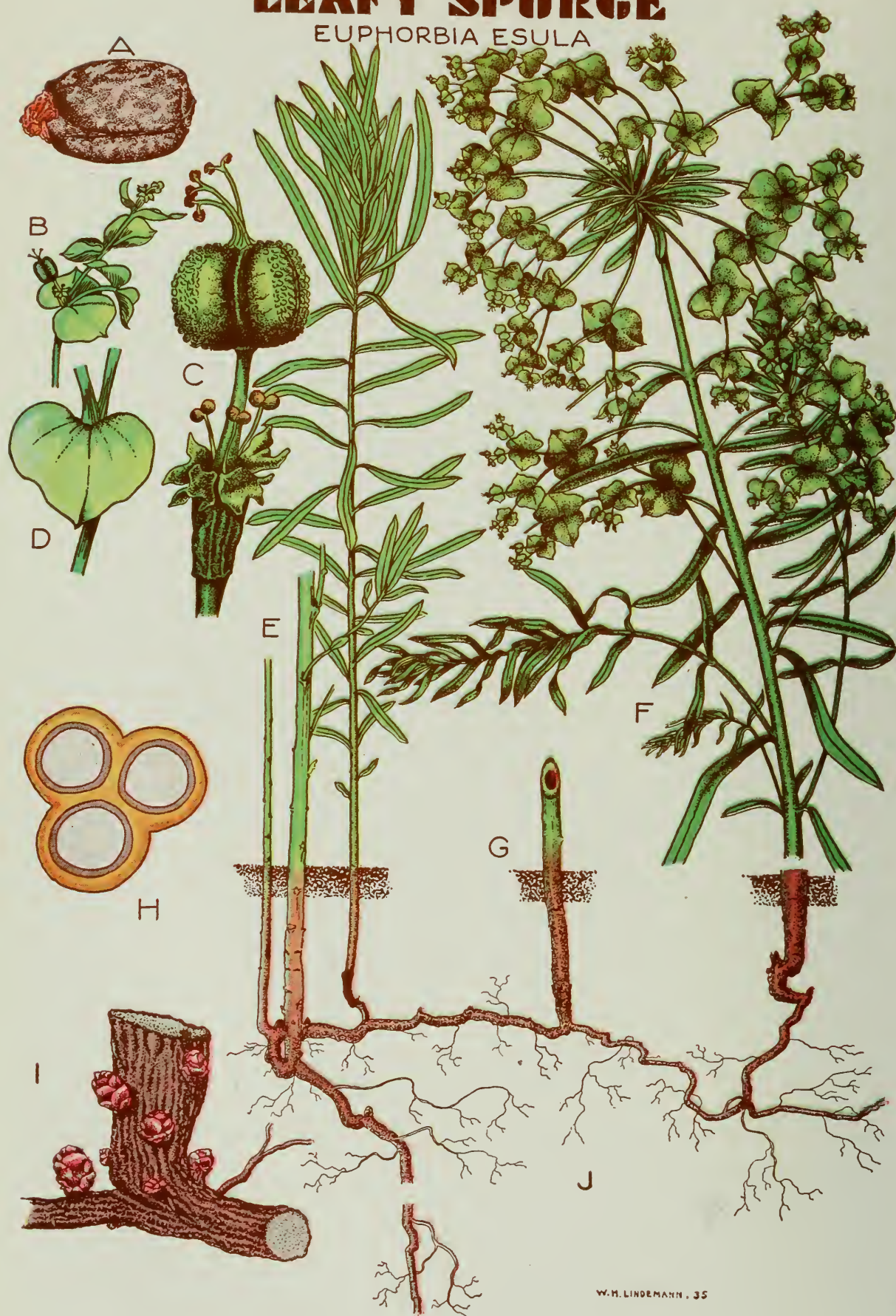


Fig. 35. Black Medick or Yellow Trefoil (*Medicago lupulina*).

Control. This plant does not persist when a field is plowed and brought under cultivation, and therefore is seldom troublesome when a short rotation of crops is followed.

LEAFY SPURGE

EUPHORBIA ESULA



W. H. LINDEMANN . 35

Plate 3.

THE SPURGE FAMILY (EUPHORBIACEAE)

Leafy Spurge, Betcher Weed, or Faitours Grass (*Euphorbia esula*, L.)

This is a pernicious perennial weed which has come to this country from Europe. It has been known in the United States for about one hundred years and was first observed in Ontario many years ago. It was early recognized as a weed that was likely to become troublesome, and has fully lived up to this expectation. Patches of this weed are now found in practically every county in Ontario. They are chiefly on roadsides, fence lines and in pasture lands and vacant lots. In recent years these patches have increased to an alarming extent, both in size and in number. In Ontario, Leafy Spurge grows so vigorously that it soon crowds out all other vegetation. In Western Canada, in many parts of the United States, and in New Zealand, this weed has proved a most serious menace to agriculture. It is considered so dangerous to Canadian agriculture that the Dominion Government has recently placed it on the prohibitory list of noxious weeds in the regulations of The Dominion Seeds Act. This means that no seed of any kind can be sold for seeding purposes that contains even a single seed of Leafy Spurge. The seed is somewhat larger than red clover or alfalfa seed, and careful cleaning, using correct screens and riddles, is necessary to remove it from the seeds of these legumes.

Description. Leafy Spurge is a long-lived, deep-rooted, perennial weed, reproducing by seed and underground root-stocks. The root system is very conspicuous. It extends deep into the soil, often to a depth of more than ten feet. In addition to the deep vertical roots there are numerous lateral root-stocks with buds from which new plants grow. The stems are from 1 foot to 3 feet high. The leaves are long, narrow, entire and smooth to the touch, bluish green in colour, turning reddish in the fall. The flowers are greenish yellow in flat-topped, umbel-like clusters with a ring of leaf-like bracts at the base of each cluster. The seeds are borne in three-lobed fruits or capsules. They are ovoid, smooth, a light gray in colour with brownish spots, and have a dark line down one side and a yellowish appendage at the point of attachment.

Time of flowering, June to September.

Time of seeding, July to October.

Dispersal: By creeping underground root-stocks and as an impurity in seed grain, clover and grass seeds.

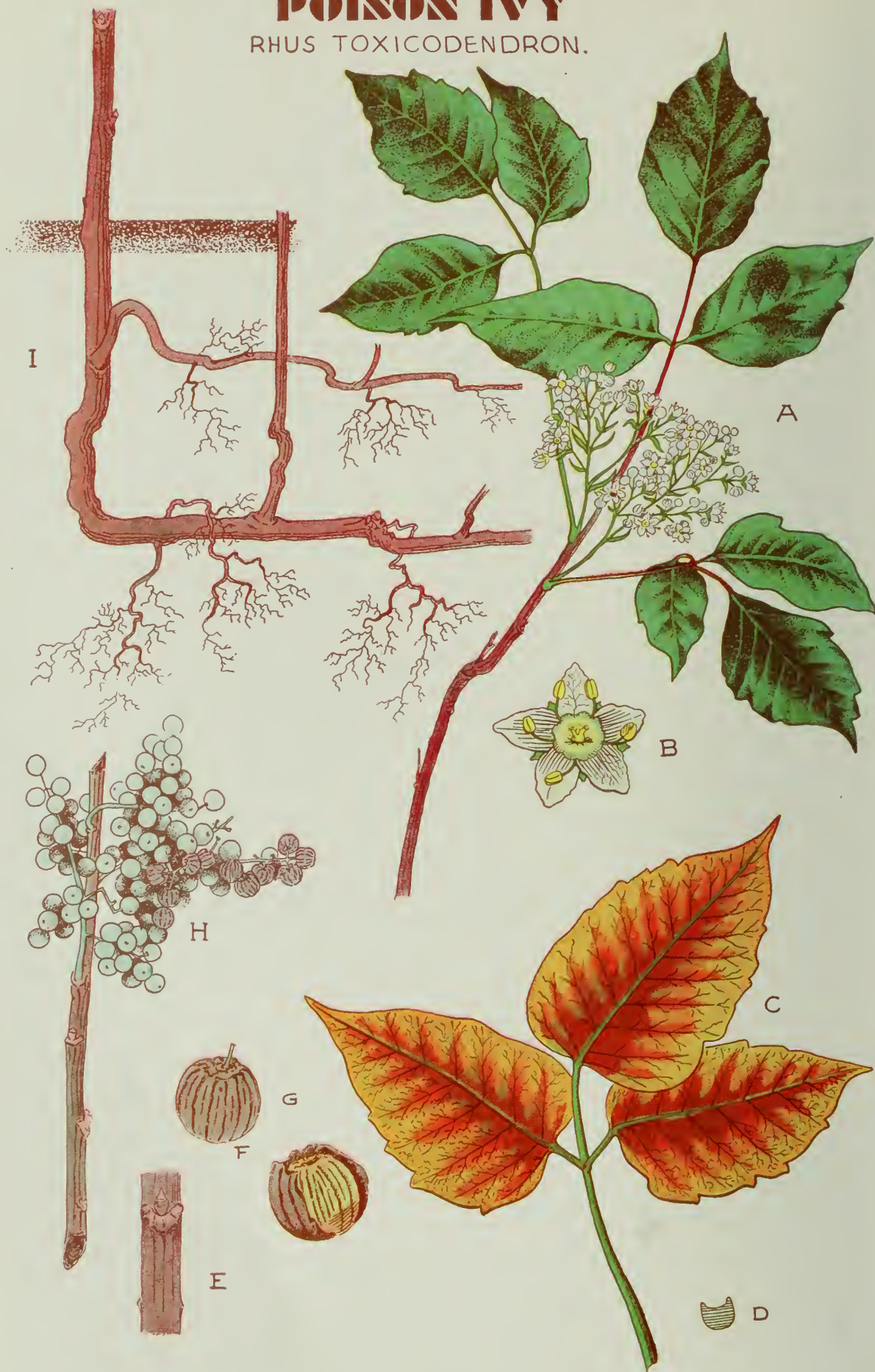
Control. Leafy Spurge produces a great quantity of seed and should never be allowed to go to seed. The root system is very extensive and stores enormous quantities of food. Such a root system makes this weed extremely difficult to destroy, either by cultivation or chemicals. Great care must be taken in dealing with small patches of this pest. Do not cultivate through small patches for fear of spreading pieces of the underground root-stocks over the rest of the field. Small patches of Leafy Spurge are best dealt with by spraying with sodium chlorate or with a weed killer containing this chemical. Large areas infested with Leafy Spurge should be taken out of crop production at once and put under clean cultivation until all the plants are killed. This means a bare, black summer fallow. Those who have had experience with this weed on large areas claim that it requires two years of black summer fallow to bring it under control. This summer fallow should be followed by a smother crop or by grain heavily seeded to clover.

Cypress Spurge, or Graveyard Weed (*Euphorbia cyparissias*, L.)

This is another perennial weed of the same family which is often abundant on roadsides, headlands and in permanent pastures. It was once thought to be worthy of cultivation and was quite extensively planted in cemeteries, where it proved a great nuisance, and thus became known as Graveyard Weed. It is somewhat similar but much smaller than Leafy Spurge. The stems are in dense clusters 6 to 14 inches

POISON IVY

RHUS TOXICODENDRON.



W.H. LINDEMANN. 35

high with numerous narrow, bluish green leaves and dense, flat-topped, yellow flower clusters. Patches of this weed can be destroyed by spraying with a chemical weed killer.

THE CASHEW FAMILY (ANACARDIACEAE)

Poison Ivy (*Rhus toxicodendron*, L.)

This pest is dealt with in this bulletin not because it is a weed in cultivated fields, but because it is a menace to children and adults. It is seen along fences, on roadsides, and in woods and thickets in many parts of Ontario. It is found in the neighbourhood of numerous summer resorts and bathing beaches and sometimes on the edges of children's playgrounds. It causes much discomfort and misery to many people, and everyone for his own safety should learn to recognize it.

Description. Poison Ivy is a low, bushy plant, usually. It may, however, vary in height from a few inches to three feet or more. Sometimes it grows as a woody vine trailing in the leaf mould, scrambling over fences and walls or climbing to quite a height on trees by means of masses of small rootlets. It is most readily recognizable by its leaves, which are compound with the leaflets in threes at the top of the stem. The leaflets vary in outline from somewhat egg-shaped but more pointed to somewhat obliquely four-sided. (See illustration.) They are quite smooth and firm, with the edges sparingly toothed or entire. At the approach of autumn the leaves become coloured with beautiful shades of scarlet or orange. Early in the summer inconspicuous clusters of small greenish yellow flowers develop in the axils of the leaves and are followed by spherical whitish fruits about the size of a pea. These become dry and firm and remain on the plant during the winter.

Control. Poison Ivy is easily destroyed by cultivation, but unfortunately it nearly always grows in places where cultivation is impossible. Small patches can be eradicated by grubbing out the plants, roots and all, with a pick and fork or pulling them out with gloved hands. The danger from poisoning can be reduced by spraying the plants with strong brine, 3 lbs. of salt to a gallon of water, a week or more before grubbing them out. In working among Poison Ivy, rubber boots and gloves should be worn, and these should be washed at the end of each period of work. Persons highly susceptible to poisoning should leave the work to others. Spraying with a chemical weed killer containing sodium chlorate has proven to be the most practical and effective method of eradication for patches of Poison Ivy of any considerable size.

THE ST. JOHN'S-WORT FAMILY (HYPERICACEAE)

Common St. John's-Wort (*Hypericum perforatum*, L.)—Fig. 36

This weed is sometimes troublesome in permanent pastures and meadows. It does not persist where a systematic short rotation of crops is practised.

Common St. John's-Wort is a perennial weed with slender creeping "roots;" stems clustered, woody at the base, upright, from 1 to 2 feet high; leaves without stems (sessile), opposite, entire, elliptic or linear oblong in outline, black dotted on the edges, and with semi-transparent dots all over, which can be readily seen when the leaves are held up to the light; yellow flowers borne in loose terminal clusters, the petals with black dots on the margin. The seeds are about $\frac{1}{24}$ of an inch long, cylindrical, rounded at the ends, dark brown to black in colour.

Time of flowering, June to September.

Time of seeding, July to October.

Control. In meadows or pastures which cannot be brought under cultivation, close cutting several times during the summer is recommended. An application of salt, a small handful to each plant after close cutting in hot, dry weather, is also recommended where the weed is not too abundant. If the land can be cultivated and brought under a systematic rotation of crops, the St. John's-Wort will soon be suppressed.



Fig. 36. Common St. John's-Wort (*Hypericum perforatum*).

THE EVENING PRIMROSE FAMILY (ONAGRACEAE)

Common Evening Primrose (*Oenothera biennis*, L.)—Fig. 37

A tall, stout, native biennial weed found frequently in Ontario in hay fields and on the edges of cultivated fields. The leaves are from 1 to 6 inches long, oblong to

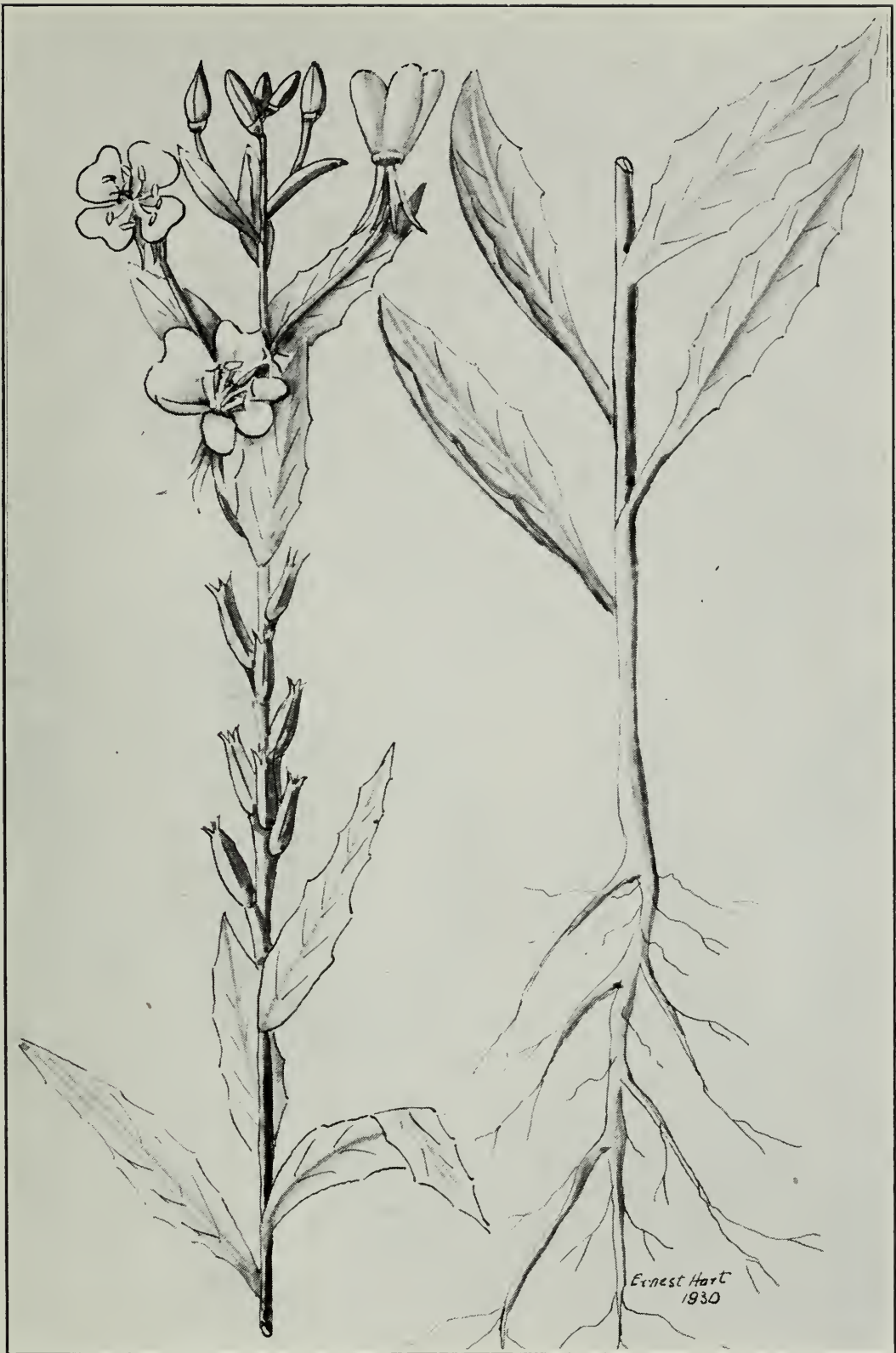


Fig. 37. Common Evening Primrose (*Oenothera biennis*).

lance-shaped, with wavy, slightly toothed margins. Flowers open in the evening and are large and bright yellow in colour. Seed pods lie close to the stem and are about an inch in length. Seeds are reddish brown and irregular in outline, four to five-sided.

Time of flowering, June to September; seeds ripe by August.

Dispersal: By seeds.

Control. Spud out plants on the headlands and in the fence corners. Never troublesome when a field is brought under cultivation.



Fig. 38. Spotted Cowbane or Water Hemlock (*Cicuta maculata*).

THE PARSLEY FAMILY (UMBELLIFERAE)

Spotted Cowbane, or Water Hemlock (*Cicuta maculata*, L.)—Fig. 38

A weed of wet, marshy places. Cattle are frequently poisoned by eating the roots of this plant, especially early in the spring when pasture is scarce.

A smooth perennial from 2 to 5 feet high. Leaves compound, of two or three divisions; the stalks with expanding bases which clasp the stem; the leaflets lance-shaped and sharp-toothed. The flowers are small, white and in flat-topped clusters

(umbels). The root consists of a number of spindle-shaped "tubers."

Control. Watch marshes and low places for this weed and hand pull any plants that are found. This is easily done if the roots are first loosened with a spud or other implement. Be sure to destroy the plants after pulling them.

Wild Carrot, Bird's Nest, or Devil's Plague (*Daucus carota*, L.) Plate 5

This is a biennial, naturalized from Europe, with a deep, strong tap root, a bristly stem, and much-divided leaves like the cultivated carrot. The clusters of flowers are in compound umbels which resemble bird-nest cavities.

Time of flowering, July to September. Time of seeding, August to December.

Dispersal: By seeds carried by wind and animals.

Control. Spudding is quite effective when the roots are cut before blossoming the first season. When the field becomes badly infested it should be plowed and cultivated and treated to a hoed crop. Sheep will suppress it in pasture lands. A chemical weed killer can be used to advantage to destroy Wild Carrot on roadsides and in permanent pastures.

THE MILKWEED FAMILY (ASCLEPIADACEAE) Milkweed, or Silkweed (*Asclepias syriaca*, L.)

This plant quite frequently appears in cultivated crops in Ontario, and once it becomes established its extermination is a difficult task.

It is a deep-rooted perennial weed, with a stout stalk from 2 to 5 feet high, covered with soft hairs. Leaves large, lance-oblong to broadly oval, with fine down on the under surface. Flowers dull purple to white in colour and borne in compact clusters (umbels). Fruit, a large pod which opens down one side (follicle) to allow the white plumed seeds to escape.

Control. Cut early to prevent from seeding. Spud out scattered plants in meadows and grain fields. If a field is very badly infested, break it up and follow one of the methods suggested for Perennial Sow Thistle.

THE MORNING GLORY FAMILY (CONVOLVULACEAE) Field Bindweed, or Wild Morning Glory (*Convolvulus arvensis*, L.)

This pest, which came to this country from Europe, is the most difficult of all Ontario weeds to eradicate once it becomes established in a field. Probably no other weed threatens the farmers of Ontario with such loss as Field Bindweed does. It is even harder to eradicate than Perennial Sow Thistle, though the seeds are not spread far and wide by the wind as is the case with the Thistle. No crop will grow once Bindweed is well established. It thrives on almost any kind of soil, and neither wet nor dry seasons seem to affect its growth. Some farms in Ontario have already been abandoned on account of this weed. Others are so badly infested with it that loan companies refuse to lend money on them; and many fields on other farms are unprofitable to work on account of the Bindweed.

Bindweed is found more or less throughout the older counties of Ontario. On most farms it occurs only in small patches here and there throughout the fields, but on some farms it covers many acres and has practically taken possession of the land. The areas worst infested with Bindweed are in Western Ontario, chiefly in the sugar beet growing districts. There is much evidence for the claim that the seeds of this

WILD CARROT

DAUCUS CAROTA



WM H LINDEMANN.

FIELD BINDWEED

CONVOLVULUS ARVENSIS



Plate 6.

weed have been spread as an impurity in imported beet seed. There seems to be no doubt that many farmers have also sown seed grain containing the seeds of this pest. The seeds of Bindweed are large, angular, rough surfaced, and are very hard to separate from grain. Farmers should therefore be on the watch for the seed of this weed in their seed grain. There is no excuse for this large seed being left in properly cleaned clover or grass seed.

The reason that Bindweed is getting a hold on so many farms is chiefly owing to the fact that farmers are not familiar enough with it and do not recognize it in time to prevent it from getting established here and there in their fields in patches, from which its root-stocks are soon scattered all over the field by farm implements such as the harrow and cultivator. The chief reason the farmer does not know this weed when it first appears in the field is because it usually takes two or three years to come into bloom. Most farmers recognize it readily by its flowers, but are not familiar with its stems and leaves. It is important therefore that farmers should get to know it by its stems and leaves as well as by its flowers.

Description. Field Bindweed has very extensively creeping, cord-like root-stocks which penetrate the soil to a depth of four feet or more, and any piece of the root-stock possessing one or more buds is capable of starting a new plant. The stems are slender and branching, and either trail on the ground or climb by twisting around other plants. The leaves are rather small, somewhat arrow-shaped, with blunt or rounded tips. The flowers are white or rose-coloured, funnel-shaped, about 1 inch across. They are borne singly in the axils of the leaves on slender stalks about the length of the leaves. The seeds are large, about $1/8$ to $1/6$ of an inch in length, irregularly pear-shaped but angular, gray-brown or seal-brown in colour, with the surface coarsely roughened, and they are usually three in number in a spherical seed pod. An average plant produces about 160 seeds.

Time of flowering, June to September.

Time of seeding, August to October.

Dispersal: Chiefly by means of creeping root-stocks, sometimes as an impurity in seed grain, beet and mangel seed.

Control. Small patches of Bindweed should be isolated from the rest of the field and worked separately to avoid dragging the root-stocks on implement teeth from infested to non-infested areas. These small patches can be destroyed by spraying with a chemical weed killer.

If a field or large part of it becomes overrun with this weed, spraying with a chemical weed killer is decidedly expensive, and some method of cultivation and cropping will usually have to be resorted to. Experiments have shown that Field Bindweed or Wild Morning Glory has withstood the treatment of destroying all the top growth longer than any other weed. It takes at least two years of continuous black summer fallow to starve this weed. One of the most promising methods of cropping and cultivation for the eradication of Field Bindweed consists of planting corn in hills 42 inches apart so it can be cultivated in four different directions. Corn planted in this way should be grown continuously for two or three years, or until all growth of the Bindweed disappears. Bindweed tends to cling to the corn plants, and care should be taken to hoe out these plants in the corn hills which are missed by the cultivator. This method requires much work, but Bindweed is a most persistent and destructive weed, and there is no easy way of eradicating it. The following method, which also requires a lot of labour, has been found to give results in the control of Bindweed:

Get on the field just as soon as the land is dry enough to permit of cultivation. Do not give the Bindweed a chance to make any early spring growth. If the field is in sod, plow shallow. If the land was plowed in the fall it will not be necessary usually

to plow again in the spring. Cultivate every week or ten days with a cultivator with broad points that will cut the plants off an inch or two below the ground without bringing the creeping root-stocks to the surface. Continue cultivation until it is time to put in a hoed crop: turnips, mangels, rape, or, if you are in a section where the corn borer is not troublesome, corn may be planted. It is best to put it in hills 42 inches apart so that it can be cultivated both ways. As soon as the hoed crop is up, cultivate it at least every two weeks, oftener if possible, until it occupies all the land and makes further cultivation impossible. Just as soon as the crop is harvested, plow shallow and then cultivate every ten days or two weeks with a broad-share cultivator. It is very important to cultivate as soon as the crop is off, so that the Bindweed will not have a chance to get started into late fall growth.

Last thing in the fall rib up the land into drills, and allow to stand over winter. The following spring start cultivation with the broad-share cultivator as soon as you can get on the land. Repeat frequently enough to prevent the Bindweed making any growth above the ground, until the first or middle of June. Then sow pasture rape (Dwarf Essex variety) or turnips, in drills 26 to 30 inches apart, at the rate of about 1½ lbs. per acre. As soon as the crop is up, cultivate every week or ten days until it occupies all the ground and makes further cultivation impossible. If the Bindweed should get started in the rows, hoe it out as completely as possible. This, however, should not be necessary if the previous cultivation has been frequent and thorough.

Some farmers resort to a black summer fallow for two years in succession in order to eradicate this most pernicious pest. This method is costly, as the crop is lost for two years and it involves much labour, but some men claim it is the only method that will completely rid a field of Bindweed. In using a summer fallow, plow deeply in the early spring and cultivate thoroughly at regular intervals until late fall, using a stiff-toothed cultivator or a spring-tooth cultivator with shares that overlap. Lots of power is important in order to cultivate during hot, dry weather. Frequent plowing in order to bring the root-stocks up to the sun will help to make a more thorough clean-up. In experiments conducted at the Ontario Agricultural College to determine what effect the sun's heat would have on the root-stocks of Bindweed, it was found that after one day's exposure to sun and air during June, July and August, 100 per cent of the root-stocks were killed. This emphasizes the importance of cultivation during mid-summer. Cultivate every four to seven days until fall. Plow and leave the land in the rough state all winter or rib it up last thing in the fall. Begin the cultivation as early the following spring as possible and continue it until it is time to sow fall wheat or rye, or until late fall if spring grain is to be sown the next year. The experience of many farmers shows that it takes at least two years and sometimes three years of complete black summer fallow to kill Bindweed. The effectiveness of the fallow will depend upon the season, the implements used, and the thoroughness of the job. Many farmers stop fighting Bindweed too soon. After they have killed 90 per cent of the root-stocks they stop their fight and leave the remaining 10 per cent to start further trouble. It is usually advisable to follow a two-year's summer fallow by seeding down the field to clovers, preferably alfalfa, and leaving it seeded down as long as profitable. Any root-stocks of Bindweed that are still in the field will not get a chance to spread in this sod, and the cutting of the crop two or three times a year will prevent any Bindweed seeds from maturing.

Clover Dodder, Devil's Gut, or Strangle Weed (*Cuscuta spp.*)

This weed is a menace to clover and alfalfa seed production in Ontario. Practically all agricultural countries prohibit the importation of any clover, alfalfa or grass seed containing even a trace of Dodder seed. The Federal Government at Ottawa recently has added Dodder to the list of prohibited weeds of The Dominion Seeds Act, thus making it an offence for anyone to sell clover, alfalfa or grass seed containing a single

seed of Dodder. The ordinary cleaning mills will not remove Dodder from red clover, alfalfa, sweet clover and alsike seeds, and so far no machinery will make a 100 per cent separation. These facts are surely warning enough to every farmer in Ontario to guard against the introduction of Dodder onto his farm and to take immediate steps to clean his land of this pest if it has already appeared in his fields. Dodder has been introduced from Europe and is now found in many parts of the United States and Canada, more especially in those areas having a long summer season without frost. Dodder has been found in various parts of Ontario, but is largely confined to the southern counties bordering on Lake Erie. Until quite recently it was thought that Dodder would not persist in the colder parts of the Province. During the last few years, however, it has been found growing and producing seed as far north as Owen Sound and on farms near Peterborough as well as in other northern districts. It undoubtedly thrives best in those parts of the Province having a comparatively warm winter, but it appears to be gradually acclimatizing and establishing itself in the northern part of the Province. Therefore farmers in every part of the Province should be on the lookout for it.

Description. Dodder is very easy to recognize, as it differs so markedly from ordinary weeds in possessing no leaves. The yellow, thread-like stems of the plant twine around the clover and alfalfa plants and send into their tissues short suckers called haustoria. By means of these suckers the Dodder draws from the clover the food necessary for its growth and reproduction. It thus kills the clover by robbing the plant of its food and causing it to starve. The yellow, thread-like stems of the Dodder first appear quite early in the season and soon become disconnected from the ground. They soon spread from plant to plant until a tangled mass of yellow threads covers the whole patch of clover or alfalfa. Badly infested fields may become entirely covered with this pest in a short time. On these yellow threads are produced dense clusters of small white flowers which are succeeded by round, brown seed pods. Each plant produces a large number of seeds. The seeds are gray or yellowish brown. They vary in size from $1/24$ to $1/15$ of an inch and vary greatly in shape, but are generally somewhat oval in outline, and the surface is dull and roughened.

Time of flowering, July to November; seeds ripe by September.

Dispersal. Chiefly dispersed as an impurity in clover and alfalfa seed, but sometimes by means of pieces of the stem adhering to clover or alfalfa in hay, and viable seeds in stable manure. It may also be transferred from farm to farm by separators.

Control. Pure seed is of the utmost importance to prevent the introduction of this weed onto the farm. Do not sow any clover or alfalfa seed which has not been tested and graded by one of the Dominion Seed Laboratories. It is not safe to buy clover or alfalfa seed from your neighbour unless his seed has been tested and certified free from Dodder by an official seed analyst. It is important to watch the threshing mill when it comes to your farm. If it happens to come from a farm where Dodder grows you will almost be sure to get a few seeds unless the machine is very thoroughly cleaned. Watch carefully for the appearance of this pest in your fields. During the first season in clover or alfalfa, Dodder usually occurs in small scattered areas. If such patches of Dodder are found, prompt steps should be taken. Infested areas should be either mowed and removed before the Dodder matures seed or else burned in the field. If seed has been formed, burning is the only remedy, since it kills not only the plants but also any seeds of Dodder which may be lying on the surface of the soil. The patches in the field may be covered with straw about three feet deep, or they may be sprinkled with crude oil or kerosene and burned. If a field is overrun with this pest to such an extent that patch treatment is impracticable the safest method is to cut the crop, allow it to dry, and burn it in the field. Then disc and harrow the sod in an effort to get the Dodder seed to germinate. Ungerminated seed will lie in the soil and grow

CLOVER DODDER

CUSCUTA ARVENSIS



WM. H. LINDEMANN.

later when brought to the surface by plowing. Clover or alfalfa should not be grown on the same field again for at least five years. Dodder does not attack cereals; consequently oats, wheat, etc., can be incorporated in the rotation following the infestation of the soil with Dodder seed. A hoed crop such as corn will clean the soil of most of the Dodder seed.

THE BORAGE FAMILY (BORAGINACEAE)

Blue Bur, Stickseed, or Sheep Bur (*Lappula echinata*, Gilbert)

A disagreeable weed on roadsides, in waste places and in pastures. The burs become matted in the wool of sheep.

An introduced annual and winter annual. Erect and branching, covered with rough hairs. Leaves linear oblong, stem-leaves without stalks. Flowers small, $\frac{1}{8}$ of an inch across, pale blue in long, slender, one-sided clusters. Seeds grayish brown in colour, pear-shaped, about $\frac{1}{8}$ of an inch long, with hooked spines around the margin.

Time of flowering, from June; seeds ripe in July.

Dispersal: By seeds.

Control. In pastures and waste places continued close cutting for a number of years will prevent its seeding and finally cause it to disappear. If a field becomes very badly infested, break it up and put under a cultivated crop for a year or two. Hand pull stray specimens.

Blue Weed, Viper's Bugloss, Blue Thistle, or Blue Devil (*Echium vulgare*, L.)—Fig. 39

A biennial weed naturalized from Europe, with deep tap root which penetrates to a great depth. During the first year, the portion above ground is a rosette of leaves, and from the centre of this, next season, bristly, hairy and erect stems rise 1 to $2\frac{1}{2}$ feet high. The leaves are oblong, 2 to 6 inches in length, with both upper and lower surface hairy. The flowers are numerous, arranged in a rich spire, and are azure-blue in colour. The seeds are hard and brown in colour, with a broad base and angular body $\frac{1}{8}$ of an inch long (Fig. 39). An average plant produces 3,500 seeds.

Its names, both Latin and English, are significant of the notion that it was an effectual remedy against the bite of a viper.

The weed prefers gravelly and lime soils.

Time of flowering, July to October.

Time of seeding, August to October.

Dispersal: By seeds, especially in winter, when they are blown over the snow.

Control. This weed gives very little trouble in arable land if the cultivation is at all thorough. In fence corners, on roadsides and in waste places, cutting below the crown with a spud is practically the only effective method of destroying the weed. Sometimes, however, this is impracticable, because of the number; and in such cases some special treatment, similar to that recommended for the Dock, may be resorted to.

This weed can be destroyed with a chemical weed killer.

Hound's Tongue, Dog Bur, or Burs (*Cynoglossum officinale*, L.)—Fig. 40

A biennial weed, with erect hairy stem, of rank growth, and much branched, 1 to 3 feet high. The lower leaves have petioles; the upper ones clasp the stem. They are 6 to 12 inches long and covered with downy hair, and have a disagreeable odour resembling that of mice. The flowers are small and lurid purple-red in colour. The fruit consists of a broad, rounded bur, $\frac{1}{4}$ of an inch long, with one flat side, and covered



Fig. 39. Blue Weed (*Echium vulgare*).

with short spines which enable it to adhere to clothing or to animals (Fig. 40). An average plant produces about 600 seeds.

Time of flowering, June to August.

Time of seeding, July to September.

Dispersal: Chiefly by animals carrying the burs.

Control. Spud or cut deep in fall and early spring; the former to destroy the plant in its first year, and the latter to complete the destruction by removing those that escape the first cutting.



Fig. 40. Hound's Tongue (*Cynoglossum officinale*).

Pigeon Weed, Wheat Thief, Red Root, or Corn Gromwell
(*Lithospermum arvense*, L.)

A winter annual, naturalized from Europe, with reddish roots. It is usually branched, and grows to a height of 12 inches. The leaves are sessile, narrow and harsh to feel. The flowers are small and white; at maturity four small pitted seeds are produced which have considerable vitality.

Time of flowering, April to July.

Time of seeding, June to August.

Dispersal: Mainly through seed, such as wheat and rye; often spread by birds and distributed in the manure.

Control. If this weed is a serious pest adopt a short rotation of crops exclusive of fall wheat and rye. Thorough after-harvest cultivation will do much to rid fields of this weed. Plow shallow immediately after harvest and harrow and cultivate frequently.

Ground Ivy, Gill-over-the-ground, or Creeping Charlie
(*Nepeta hederacea*, L., Trevisan)

This little plant is primarily a weed in lawns. It often becomes very abundant and crowds out the grass. Once established in a lawn it is very difficult to get rid of. It is introduced into lawns through being sown as an impurity in lawn grass seed and by the seeds falling from hanging baskets in which this Ground Ivy is sometimes grown for ornamental purposes.

Ground Ivy is a low, creeping, perennial weed; the leaves small, round, kidney-shaped, the margins with rounded teeth; flowers bright blue, two-lipped, and in small clusters in the axils of the leaves.



Fig. 41. Ground Ivy (*Nepeta hederacea*).

There are several ways of eradicating this pest from lawns. One is to cover the patches of Ground Ivy with coarse salt. This will destroy all vegetation. The patches should then be thoroughly raked, removing as completely as possible any roots or stems of the weeds which may still remain. Then thoroughly drench the patches with water to wash away all the salt, after which the bare spots should be resurfaced with good garden loam and reseeded heavily with pure lawn grass seed. Ammonium sulphate can be used in the same way to destroy this weed.

Ground Ivy can also be destroyed by spraying with a solution of sodium chlorate. Use one or two ounces per gallon of water on each one hundred square feet, providing a pressure sprayer is used. If the solution is applied with the sprinkling can, a trifle more will be required, as this method is somewhat more wasteful. The leaves of the Ivy should be thoroughly covered. This method can best be carried out in the fall, though any time during the summer has been found to be satisfactory. The spray will discolour the grass for a short time but will not permanently injure it. After the Ground Ivy disappears there will probably be a very thin stand of grass, so that fertilizing and reseeded will be necessary. If the sodium chlorate is applied in the late fall it would be well to wait until early spring to reseed and fertilize. Care should be exercised in the use of sodium chlorate. It is very inflammable and will ignite from friction if allowed to dry on clothing.

It is usually wise to follow any of these treatments for the destruction of Ground Ivy with light applications of ammonium sulphate; one part of ammonium sulphate to three parts of sand by weight at the rate of 4 lbs. per 1,000 sq. ft. Immediately after this fertilizer is applied, water the grass thoroughly in order to prevent burning. Three applications a year should be given: one in the early spring, a second in June, and a third after the rains start in September. Such applications will hasten the growth of the grass and cause it to fill in the treated spots rapidly, and thus prevent Ground Ivy and other weeds from getting established again.

THE FIGWORT FAMILY (SCROPHULARIACEAE)

Mullein, or Velvet Dock (*Verbascum thapsus*, L.)—Fig. 42

The mullein is a weed introduced from Europe; very common in waste places, roadsides and gravelly or sandy pastures. It is a biennial, with large, long roots, from which spring a tall and usually unbranched stem, 2 to 6 feet high. Both stem and leaves are densely woolly all over, with branched hairs. The leaves are whitish, thick and velvety to the touch. The flowers are yellow and arranged on densely crowded elongated spikes. The capsule containing the seeds is about $\frac{3}{8}$ of an inch long, and the seeds are small, about $\frac{1}{20}$ of an inch long, six-sided, with irregular ridges running lengthwise between the pits. The colour of the seed is dark brown. An average plant produces 6,000 seeds.

Time of flowering, July to September. Time of seeding, August to November.

Dispersal: As an impurity in clover and grass seed.

Control. Mullein will not withstand cultivation and gives little trouble in fields under a short rotation of crops. Plants in permanent pastures and waste places should be cut below the ground each year when they appear.



Fig. 42. Mullein (*Verbascum thapsus*).

The MOTH MULLEIN (*Verbascum blattaria*, L.) is a worse weed than common Mullein, as it infests meadows and bears far more seed. The seed is often found as an impurity in clover and timothy. The plant itself is smooth and slender, from 2 to 6 feet high, with dentate leaves. The flower is yellow, with brown marks on the back of the petals; and the stamens have violet filaments. The seed is brown, very small, and six-sided. Treat it the same as common Mullein. In Fig. 42 are shown the seeds of the Mulleins; the lower is the Moth Mullein, the upper seed is the common Mullein.

BUTTER AND EGGS

LINARIA VULGARIS

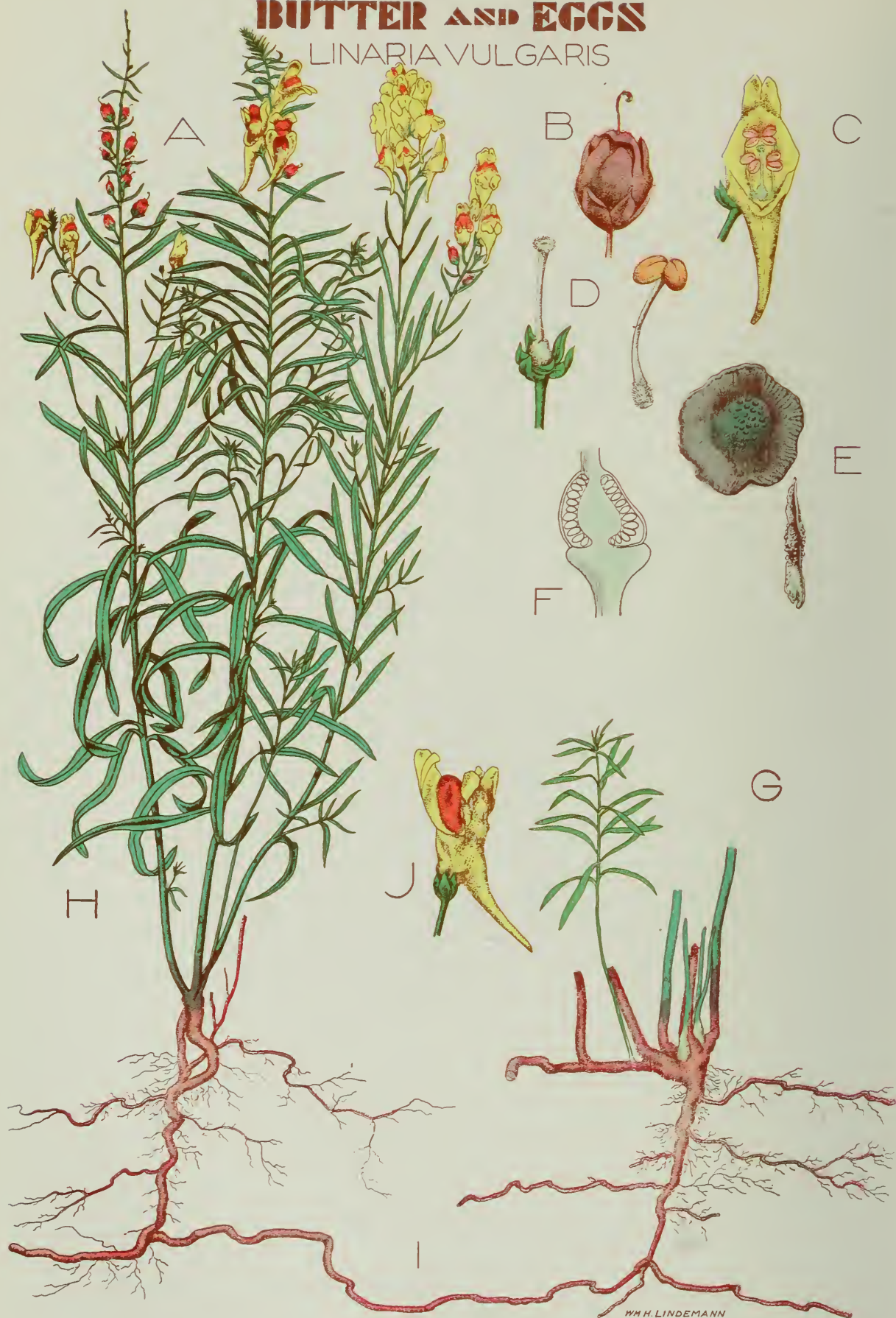


Plate 8.

Toad Flax, or Butter and Eggs (*Linaria vulgaris*, Hill)

This is a deep-rooted, perennial weed with creeping root-stocks which was introduced into this country from Europe. It appears to be becoming more prevalent and more conspicuous each year. It is seen in many parts of the Province in waste places, on roadsides, and in meadows and crops. It spreads rapidly, especially in light and shallow soils. If neglected it soon takes possession of pastures and meadows, crowding out the crop plants.

Description. The stem is erect and slender, somewhat wiry, from 12 to 18 inches high. The leaves are narrow, stalkless, and scattered along the stem at very short intervals. The flowers are distinctly two-lipped, about one inch long, bright yellow in colour, with an orange projection on the lower lip. They are borne in long terminal clusters (racemes). The seeds are dark brown or black in colour, about 1/10 of an inch in diameter, flat and disc-like, with a distinct wing around the thicker central portion, which is roughened with little projections.

Time of flowering, June to September; seeds ripe by August.

Dispersal: By seeds and root-stocks.

Control. A short rotation of crops should be practised which allows for cultivation in the spring and the fall. This should be thorough and deep. Badly infested pastures should be broken up in July and kept under clean summer fallow until fall. The following spring they should receive good cultivation until it is time to put in a hoed crop, which should be thoroughly cared for if the weed is to be eradicated. If this weed occurs in pasture land which cannot be cultivated, it can be hand pulled when the soil is wet after a rain. Small patches should be dug out or sprayed with a chemical weed killer.

THE PLANTAIN FAMILY (PLANTAGINACEAE)

Common Plantain (*Plantago major*, L.)—Fig. 43

A weed of meadows and lawns, the seeds of which are too often found in grass and clover seed.

A perennial with a short, thick root-stock bearing numerous large, dark green, oval, long-stalked leaves close to the ground. Flowers inconspicuous, borne in long dense spikes. Seed pods oval, dividing about the middle and containing from eight to sixteen small, flat, irregularly shaped brown seeds.

Control. A short rotation including a hoed crop will keep this weed in check. **"Plantain in lawns may be weeded out when the soil is firm by forcing a small implement like a chisel, with a half-rounded blade having a point like the tip of a spoon, between the soil and the fleshy crown of the weed to a depth sufficient to break the plant away from its fibrous roots without disfiguring the turf."*

Pale Plantain, or Rugel's Plantain (*Plantago rugelii*, Dene.)

This Plantain is found as frequently as Common Plantain, from which it can be distinguished by the paler green leaves with the stalks dark purple at the base, the longer and more tapering spikes with the flowers less crowded, and the seed pods, which open below the middle and contain from four to nine flat, irregularly shaped black seeds, which are larger than the seeds of the Common Plantain.

*Farm Weeds of Canada.



Fig. 43. Common Plantain (*Plantago major*).

**Ribgrass, Buckhorn, English Plantain, or Ribwort
(*Plantago lanceolata*, L.)—Fig. 44**

This is a weed which has been introduced into this country from Europe. It is often very troublesome in lawns and clover fields. It is especially troublesome in red clover. At the present time it is very hard to get red clover seed free from the seeds of Ribgrass. This is a perennial or biennial weed with a very thick root-stock from which the leaves spring. These sometimes grow erect; more generally they lie on the ground as a rosette. At the base of the leaves there are tufts of brown hair; and the leaves themselves are long, narrow and tapering, with prominent veins or ribs running lengthwise; hence some of the popular names. This flower stalk is slender and channelled, is without leaves and terminates in a dense spike. The stamens project from the inconspicuous flowers, giving a whitish appearance to the whole head. The seeds are enclosed in small pods, each containing two seeds. The seeds are about $1/12$ of an inch long, brown and shiny, with a groove on one side, in the centre of which there is a black spot. The opposite side is rounded, as are also the ends. An average plant produces 1,200 seeds.

Time of flowering, June to September.

Time of seeding, July to September.

Control. Sow pure seed. If the plants are not numerous cut below the crown with a spud. If they are, break up the field and put in a hoed crop. A short rotation of crops will soon suppress this weed. It is very common in clover fields, and it is



Fig. 44. Ribgrass (*Plantago lanceolata*).

hard to obtain clover seed free from the seeds of this weed. It is advisable to purchase only the best grade of clover seed. If the weed appears in a clover seed crop, pull the plants or the seeds will depreciate the market value of the clover seed. Special screens are required to separate this seed from red clover seed. Small quantities can be cleaned by spreading the clover seed on damp canvas. The Plantain seeds will stick to the cloth and the clover seed will drop off when the canvas is inverted.

THE TEASEL FAMILY (DIPSACEAE)

Teasel (*Dipsacus sylvestris*, Huds.)—Fig. 45

This is a tall, stout, prickly, thistle-like biennial weed found on roadsides and in pastures in many parts of the Province. It appears to thrive in stony pastures, and if neglected soon becomes very abundant.

Description. The stem is stout, prickly, 3 to 6 feet high, and bearing large, thistle-like heads. The leaves are large, lance-shaped or oblong, the margin entire or with



Fig. 45. Teasel (*Dipsacus sylvestris*).

low, rounded teeth. They have no stem, and the bases of the upper ones meet around the stem on which they are borne. Lilac-coloured flowers are in large, conspicuous, prickly heads 3 to 4 inches long. The seeds are brown, about $\frac{1}{6}$ of an inch in length, somewhat wedge-shaped, four-sided, each side with a longitudinal rib in the centre.

Control. Spud the plants below the ground or grub them out with a pick early in the summer. Teasel is but a biennial, and if prevented from seeding will soon disappear. If a badly infested pasture can be plowed and put under a cultivated crop for a year, Teasel will not persist.

THE SUNFLOWER FAMILY (COMPOSITAE)

Canada Fleabane, Horse Weed, or Butter Weed (*Erigeron canadensis*, L.)—Fig. 46

A tall, hairy plant, very common in meadows. It is a winter annual. The stem is much branched, hairy and may vary from 3 inches to 10 feet in height. The leaves are downy, from 1 to 4 inches long. The flower heads are numerous, about $\frac{1}{8}$ of an inch broad. The seeds are small, light in colour, and $\frac{1}{16}$ of an inch long, with a pappus of short, tufty hairs. An average plant produces 120,000 seeds (Kerner).

Time of flowering, June to September.

Time of seeding, June to September.

Dispersal: Chiefly by the wind.

Control. Having a small root, this weed can be pulled easily. Hence, where there is not very much of it, hand pulling is a satisfactory means of eradication. As a rule, the weed is troublesome only in meadows, and the frequent breaking up of meadow lands tends to keep it under control.

TALL DAISY FLEABANE (*Erigeron annuus*, L.) has larger and fewer flower-heads, $\frac{1}{2}$ of an inch across. It is common in meadows and along roadsides from May to November.

Great Ragweed, or Kingweed (*Ambrosia trifida*, L.)—Fig. 47

A weed in Western grain fields and in waste places in Ontario. A rough, coarse-growing annual weed from 3 to 6 feet high, with large opposite leaves which are mostly three-lobed. The flowers are of two kinds, the sterile borne on tapering spikes about 4 inches in length; the seed-producing flowers grow close to the stem in clusters in the axils of the leaves at the base of the spikes; sterile flowers $\frac{1}{4}$ of an inch across, cup-shaped, nodding; stamens yellow and conspicuous. Seed-producing flowers inconspicuous with slender purplish pistils.

Time of flowering, July; seeds ripe by August.

Dispersal: By seeds. Wheat from districts of the West often contains Great Ragweed seed.

Control. Hand pulling and mowing.

Ragweed, Hogweed, Bitterweed, or Roman Wormwood (*Ambrosia artemisiifolia*, L.)

Ragweed is very common throughout what is known as "Old" Ontario and is gradually establishing itself in "New" Ontario. It is found on roadsides, in waste places and in cultivated fields, especially neglected hoed crops. It is a vigorous plant which occupies much space and thus decreases the crop yield. It is very objectionable in pasture or fodder, as it has a bad taste and gives a peculiar odour to the milk of cows which eat it.

Not only is Ragweed a serious pest to agriculture, but also a great menace to the health of many human beings. It is one of the chief causes of hay fever from which so many people suffer. It is estimated that there are in the neighbourhood of 60,000 persons in Ontario who annually are victims of this trouble. It has been found that 80 per cent of the sufferers from hay fever develop the trouble from inhaling the pollen of Ragweed.

Description. Ragweed is an annual. The stem is much branched and slightly hairy; from 1 to 3 feet high. The leaves are very finely divided, the lower surface being of a lighter colour than the upper. It produces male and female flowers borne

in different heads on the same plant. The male flower heads are yellowish, on long, slender spikes at the ends of the branches, and the female flowers are inconspicuous, greenish, two or three together in the axils of the leaves at the base of the spikes. The seed is dark brown, about $\frac{3}{16}$ of an inch long, somewhat top-shaped, with a sharp tip around which are arranged 4 to 6 blunt spines. They have great vitality and remain in the soil a long time without injury. A single plant may produce about 5,000 seeds.

Time of flowering, July to September. Time of seeding, August to November.

Dispersal: As an impurity in seed grain and clover seed and by wind and water, being borne long distances by spring freshets.



Fig. 46. Canada Fleabane (*Erigeron canadensis*).



Fig. 47. Great Ragweed (*Ambrosia trifida*).

Control. This is only an annual weed, but nevertheless a hard weed to eradicate, as it produces its seeds low down on the plant where they are likely to be missed by the scythe or mower, and because it often seeds very late in the year after cultivation has ceased. When this weed occurs in pastures or on roadsides and in waste places, cut the plants as close to the ground as possible before the blossoms are well developed. This will prevent the formation of pollen and seeds. A second cutting should be given in September or October, as some plants are likely to make second growth and produce seed. In fields under crop, special care should be given to fall cultivation. Stubble land where this weed is prevalent should be gang-plowed and harrowed immediately

COMMON RAGWEED

AMBROSIA ARTEMISIIFOLIÁ L.



Plate 9.

after harvest and then given repeated cultivation at intervals until late fall. If the stubble land is seeded, the autumn growth should be cut with a mowing machine with the knife set low within two weeks after the grain crop is harvested. Hoed crops can be used to advantage to control Ragweed, but they should follow thorough after-harvest and spring cultivation. In order to be effective they require hoeing to destroy the Ragweed late in the season after the general cultivation is discontinued.

A three-year's rotation is very effective for the control of this pest if early-maturing crops are used, and if a practice is made of giving prompt and thorough cultivation or mowing in the early autumn after the crop has been removed. Patches of Ragweed on roadsides and in waste places can be readily killed early in the season by spraying with a chemical weed killer.

Yellow Daisy, Cone-Flower, Black-eyed Susan, or Niggerhead (*Rudbeckia hirta*, L.)—Fig. 48

A biennial and sometimes annual weed found in pastures and meadows. It grows about 1 to 3 feet high. The stems are sparingly branched and very bristly. The leaves are thick, hairy, oblong, and tapering towards the point. The flower-head is about 1 inch across, with orange-yellow rays or "petals" (ten to twenty in number), and dark purple-brown discs almost spherical or cone-shaped. The seeds are dark brown, almost black, four-angled, and about $\frac{1}{8}$ of an inch long, with no pappus or tuft of hair (Fig. 48). An average plant produces about 2,000 seeds.

Time of flowering, June to August.

Time of seeding, July to September.

Dispersal: As an impurity in timothy.

Control. Cutting or mowing this weed each year in permanent pastures or meadows will suppress it. It never gives serious trouble on land under a short rotation of crops. Sheep in sufficient numbers will cause this weed to disappear from pasture lands.

Ox-eye Daisy, White Daisy, White Weed, or Poverty Weed (*Chrysanthemum leucanthemum*, L.)—Fig. 49

The Ox-eye Daisy is a weed naturalized from Europe, and is very closely related to the Chrysanthemum or national flower of Japan. It is a perennial with short, thick root-stocks, possessed of much vitality. Very many stems spring from one root. It grows from 6 inches to 3 feet high. The leaves slightly clasp the stem; the lower ones narrow, long, and toothed along the edges, the upper ones small and without teeth. They are slightly aromatic, more perceptibly if bruised. The "flowers" are 1 to 2 inches broad, on long stalks, with from twenty to thirty white rays and a bright yellow disc. The seed is gray and white or black and white, somewhat club-shaped with a small knob at the large end about $\frac{1}{12}$ of an inch in length, surface with 12 slender conspicuous white longitudinal ribs.

Time of flowering, June to August.

Time of seeding, June to September.

Dispersal: Chiefly in grass seeds and by birds.

Control. The Daisy is most troublesome in pastures, and can be got rid of only by cultivation. If the field is in sod (meadow or pasture) plow shallow (not more than 4 inches) towards the end of August, and harrow at once. Let it stand a couple of weeks and cultivate it the same way it was plowed, 2 or 3 inches deep. After a while cultivate a little deeper. If possible, cultivate a third or even a fourth time, going a little deeper each time. Then, if you can manage to do so, rib up with a double mould-board plow the last thing in the fall. In the spring cultivate the field often enough to keep the Daisy from making any growth above ground until it is time to put in potatoes, corn, roots or rape. The hoed crop must be repeatedly and thoroughly cultivated in order to be effective.



Fig. 48. Cone Flower (*Rudbeckia hirta*).

If the field was plowed last fall, this spring cultivate thoroughly until about the middle of June, running over it frequently with the cultivator so as to keep the tops down and thus weaken the "roots." Then apply manure at the rate of about twenty tons per acre (twelve good loads). Cultivate the manure in thoroughly, and with a double mould-board plow slightly ridge up the land, making the ridges about 26 inches apart. On the ridges sow pasture rape (Dwarf Essex variety) at the rate of $1\frac{1}{2}$ lbs. per acre. It is important that the right amount of rape should be sown. Sow the rape when the land is sufficiently moist to insure quick germination of the seed. Cultivate the rape every week or ten days until it occupies all the ground and makes further



Fig. 49. Ox-eye Daisy (*Chrysanthemum leucanthemum*).

cultivation impossible. When the rape is cut or pastured, there should be none of the Ox-eye Daisies left in the field. A chemical weed killer can be used to advantage to destroy this weed in meadows and pastures.

Common Ragwort, Tansy Ragwort, or Staggerwort (*Senecio jacobaea*, L.)

This is a weed which has caused much trouble in the eastern provinces. It is a very dangerous weed, because when eaten by cattle it causes a curious and fatal disease of the liver (hepatica cirrhosa). For this reason farmers should keep a sharp lookout for it and destroy it whenever it appears.

Common Ragwort occurs on roadsides and in pasture fields in the neighbourhood



Fig. 50. Ragwort, Tansy Ragwort or Staggerwort (*Senecio jacobaea*).

of Guelph, and has been collected near Burlington, Ont., and is reported as occurring in Lincoln County.

Description. It is a large, conspicuous, strong-growing, perennial plant from 2 to 3 feet high. The flowers are in numerous heads in flat-topped clusters, bright yellow in colour and very showy. The root leaves are from 6 to 8 inches long with distinct stems (petioles). The stem leaves are stemless (sessile) and clasping. All leaves are dark green and finely segmented, the segments crowded, overlapping, crisp and wavy.

Control. If they are not too numerous, grub out the plants, roots and all. If they are numerous, plow up the field and bring it under a short rotation of crops. If the land cannot be broken up, cut the weed in time to prevent it from seeding, for several successive years. Keep cattle off fields in which this weed is growing.

Yarrow, or Milfoil (*Achillea millefolium*, L.)—Fig. 51

This is a very common perennial weed which grows on roadsides, in pastures and in lawns throughout the Province. It readily succumbs to cultivation and gives little trouble in fields under cultivated crop.

Description. The erect plants are from 6 inches to 2 feet high, with finely divided, fern-like leaves and flat clusters of white or pink flower-heads (see Fig. 51). The seeds are gray with a white margin, flat, oblong, wedge-shaped in outline, about $\frac{1}{16}$ to $\frac{1}{12}$ of an inch in length; surface has very indistinct, irregular, longitudinal lines.



Fig. 51. Yarrow (*Achillea millefolium*).

They are often found in grass seed mixtures.

Control. If a field badly infested with Yarrow can be plowed and brought under a short rotation of crops, this weed will soon disappear. Badly infested meadows and pastures which cannot be broken up should be mowed early enough each year to prevent the Yarrow from seeding.

Common Tansy (*Tanacetum vulgare*, L.)

This is a strongly aromatic perennial plant, somewhat resembling Yarrow. It has dark green, finely divided leaves and flat-topped clusters of yellow, rayless flower-heads. It is found in pastures, on roadsides, and in waste places in many parts of Ontario. It does not, however, give trouble in cultivated crops. It can be dealt with in the same way as Yarrow.



Fig. 52. Burdock (*Arctium minus*).

Lesser Burdock, Bur, Clot-Bur, or Beggar's Button
(*Arctium minus*, Bernh.)—Fig. 52

A biennial weed with tremendous roots, probably the largest of all weed roots. This root is uniform in size for a foot below the surface; farther down it is much branched and has a great hold on the ground. The stem is much branched (from 4 to 6 feet high) and rough, with broad, rounded leaves, the lower surface of a lighter green than the upper. The flower-heads occur in clusters and are purple in colour. The flower cup, or involucre as it is called, is composed of hooked spines, which are very adhesive, and do much injury to the wool of sheep. The seeds are brown, $\frac{3}{8}$ of an inch long and spotted with darker brown (Fig. 52).

Time of flowering, July to September.

Time of seeding, August to October.

Dispersal: Chiefly by animals carrying the seed from place to place.

The plant when burned yields a good quality of alkaline ash, equal to the best potash; and a decoction from the roots is said to be equal to the juice of Sarsaparilla as a blood purifier, etc.

Control. Cut below the ground with a spud and burn the tops. A handful of salt applied after cutting in hot, dry weather will kill this plant.

Canada Thistle, or Creeping Thistle (*Cirsium arvense*, L., Scop.)—Fig. 53

This weed was originally introduced from Europe, and hence is incorrectly named Canada Thistle. It is a hardy perennial, with numerous underground stems which bear a large number of shoots. (See Fig. 53, illustrating two of these shoots.) It grows to a height of 1 to 3 feet. The leaves are narrow and long, deeply indented into very prickly, lobed segments. The leaf has a crimped appearance, and at the base slightly clasps the stem. The under surface of the leaf is woolly, the upper surface less so. It produces numerous heads, which are $\frac{1}{2}$ to $\frac{3}{4}$ of an inch across and of a lilac-purple colour. The flower-head is smaller than that of other thistles. The seed is gray, oblong, and about $\frac{1}{8}$ of an inch long, with slight longitudinal markings. Attached to the top is a conspicuous tuft of long hair (the pappus) (Fig. 53). The seed is carried long distances by the wind. An average plant produces 3,500 seeds.

Time of flowering, June to August.

Time of seeding, July to September. Many plants produce no seed.

Dispersal: Chiefly by the wind.

Great care should be taken to prevent Canada Thistle from seeding.

Control. The Canada Thistle can be controlled in several ways if thorough work is done at the right time:

(1) By a regular short rotation of crops with thorough cultivation. A good rotation is one of clover, hoed crops and cereal crops. First year, two cuttings of early red clover followed by deep plowing and cultivation. Second year, hoed crops with clean cultivation. Third year, a cereal crop, seeding down again with clover.

(2) By summer fallowing. Plow deeply in the summer just as the flowers begin to open. Cultivate at intervals with a broad-share cultivator, so as not to let the Thistle get any growth above the ground during the growing season.

(3) Dry cleaning method for Perennial Sow Thistle described on page 116.

Russian Knapweed (*Acroptilon picris*, D.C.)—Fig. 54

This is a weed for which Ontario farmers should be on the lookout, as it is a very persistent perennial plant, reproducing freely by seed and underground root-stocks.



Fig. 53. Canada Thistle (*Cirsium arvense*).

Once it becomes established in a field, it is very hard to eradicate. It is claimed that it is as difficult to destroy as Field Bindweed, Sow Thistle or Leafy Spurge. The seed is occasionally found in alfalfa and clover seeds. Russian Knapweed is designated as a prohibited noxious weed by the regulations of The Dominion Seeds Act, so that no seed of any kind can be sold that contains a single seed of this pest. It has been found growing in one county of Ontario and there is reason to suspect, therefore, that it occurs in other counties in the Province. Everyone interested in clean farming should be on the lookout for it—in cultivated fields, grain and hay fields, on roadsides, in fence corners and waste places—so that it may be prevented from becoming established in the Province and aggravating our already serious weed problem.

Description. Russian Knapweed is a perennial with numerous spreading, creeping, underground root-stocks. The stems are from 1 to 4 feet high and are covered with

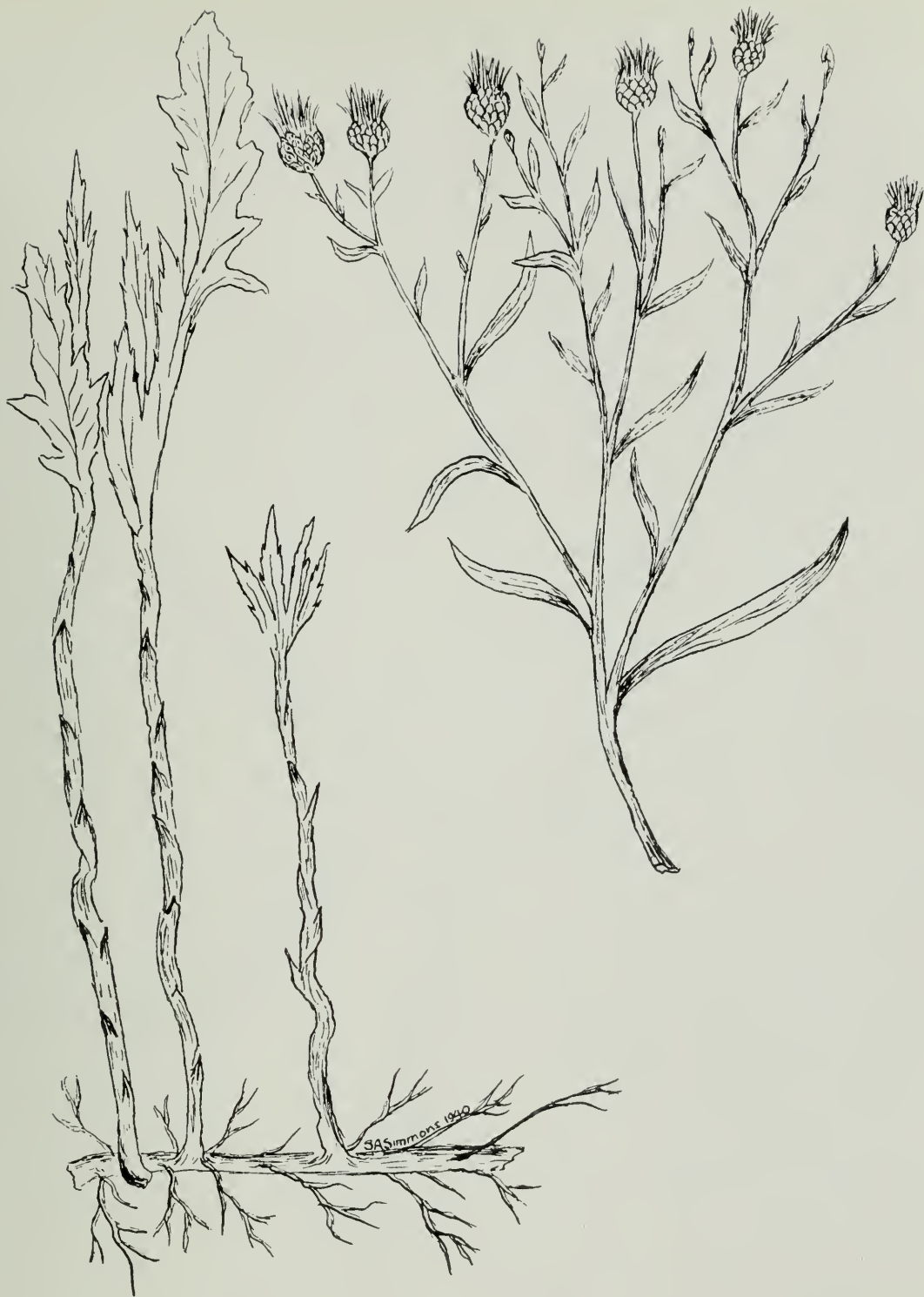


Fig. 54. Russian Knapweed (*Acroptilon picris*).

downy white hairs. The leaves are slightly hairy, the lower ones lobed, the upper ones entire (see Fig. 54). The flowers are blue to purple or rose-coloured, in heads about $\frac{1}{2}$ of an inch in diameter. The seeds are white, about $\frac{1}{8}$ of an inch long, somewhat egg-shaped in outline but flattened.

Control. Sow only seed that has been tested and graded. Promptly dig out all plants of this pest that may be found, wherever they occur. In digging them out be sure to get all the underground root-stocks. If this weed is found in patches so large that digging would involve too much work, spray such patches two or three times with a strong chemical weed killer with a sodium chlorate base.

Chicory, or Wild Succory (*Cichorium intybus*, L.)—Fig. 55

A perennial weed introduced from Europe, with long, deep tap root, which when dried and ground up is used in adulterating coffee and as a substitute for it. The stems are almost leafless, from 1 to 3 feet high, much branched, slightly hairy and whitish in colour. The leaves, spread out on the ground, are long with irregular edges. The flower-heads are numerous, occurring in clusters, without flower stalks, on the naked branches. The "flowers" are about $1\frac{1}{2}$ inches across, bright blue in colour, and are usually closed by noon. The seed is about $\frac{1}{8}$ of an inch long, tapering to a blunt point, the opposite end having a fringe of minute scales around the crown. The body of the seed is corrugated. An average plant produces about 3,000 seeds.



Fig. 55. Chicory (*Cichorium intybus*).

Time of flowering, July to October.

Time of seeding, August to October.

Dispersal: Frequently as an impurity in clover and grass seed.

Control. Seldom troublesome in well-cultivated fields. A short rotation of crops will soon cause it to disappear. Badly infested fields may be cleaned by deep, thorough fall cultivation, followed by a hoed crop the next season. This weed is easily killed by spraying with a chemical weed killer.



Fig. 56. Fall Dandelion (*Leontodon autumnalis*).

Fall Dandelion, or August Flower (*Leontodon autumnalis*, L.)—Fig. 56

An introduced perennial weed reported recently from several places in Ontario as occurring in hay fields. Leaves mostly basal, springing from a short, thick root-stock, and resembling somewhat the leaves of the Common Dandelion. Stems branched, scaly and few flowered. "Flowers" about 1 inch across; bright yellow. Seed is $\frac{1}{4}$ of an inch long, brown, linear, ribbed lengthwise, and bears a row of feathery bristles about its own length (Fig. 56).

Time of flowering, July till frost; seeds ripe by August.

Dispersal: By seeds and by division of the crown.

Control. *"Badly infested fields should be brought under cultivation. Pasture lands that cannot be cultivated may be improved by severely raking the surface with a spring-tooth harrow and sowing the most vigorous grasses."

Yellow Goat's-Beard, Meadow or Wild Salsify (*Tragopogon pratensis*, L.)—Fig. 57

This is a weed common along roadsides, railway tracks, and in waste places in many parts of Ontario. No reports have been received of it persisting in cultivated fields. However, specimens are frequently sent into the Department of Botany for identification, as it is a very conspicuous plant both in flower and seed (Fig. 57).

Yellow Goat's-Beard is a perennial weed naturalized from Europe. It has a long, slender tap root; an upright stem from 1 to 3 feet high; leaves keeled, long, narrow, taper-pointed; large yellow flower-heads from 1 to 2½ inches broad, which are succeeded by conspicuous spherical heads of downy seeds looking like very large dandelion seed heads. The seeds are yellowish brown, long and slender, somewhat spindle-shaped, tapering to a slender beak which bears a tuft of hairy bristles; the surface is lined lengthwise and somewhat roughened with little projections. The whole plant is filled with a milky juice.

Time of flowering, June to September.

Time of seeding, July to September.

Control. This weed does not appear to stand cultivation, as it is seldom seen in fields which are under crop. If it becomes abundant in meadows or pastures, breaking these up and keeping them under cultivation for a year or two should cause it to disappear. Stray plants on roadsides, headlands and waste places should be cut early enough to prevent them from seeding.

Salsify, Oyster Plant, or Purple Goat's-Beard (*Tragopogon porrifolius*, L.)

This plant, which is cultivated as a vegetable, is often found growing on roadsides and waste places. It is very similar to Yellow Goat's-Beard except for the colour of the flower-heads, which is purple instead of yellow.

Perennial Sow Thistle, Field Sow Thistle, or Corn Sow Thistle (*Sonchus arvensis*, L.)

This is a weed which came to us from Europe and is still one of the worst weeds in the Province of Ontario. It is no exaggeration to say that Perennial Sow Thistle is a menace to Ontario agriculture. It is found growing in every county in Ontario. In certain sections of many counties it has made profitable crop production extremely difficult. It thrives in cultivated and uncultivated lands, in grain fields, in newly seeded meadows, on roadsides, along ditches and in uncleared land overgrown with brush. It grows most vigorously and spreads most rapidly in heavy, damp soils. Many of the worst infestations occur in districts where the drainage is poor.

*"Farm Weeds," by G. H. Clark.



Fig. 57. Yellow Goat's-Beard (*Tragopogon pratensis*).

However, in spite of the wide dispersal of Perennial Sow Thistle, there are still many who are not able to recognize this pest and who mistake it for its two comparatively harmless cousins, the Common Annual Sow Thistle and the Spiny Annual Sow Thistle. This should not be the case, as it is a very conspicuous weed and differs very markedly from the other two species.

Description. The Perennial Sow Thistle is a tall, coarse-growing, deep-rooted, perennial weed with large and vigorous running root-stocks. Upon these at intervals are borne buds which develop into new plants. Once it establishes itself in a field, these underground root-stocks spread out in every direction, sending up new plants every few inches, the leaves of which spread out on the ground and soon choke out the cultivated crops. The stem is comparatively smooth and hollow, and the whole

SOW THISTLE
SONCHUS-ARVENSIS

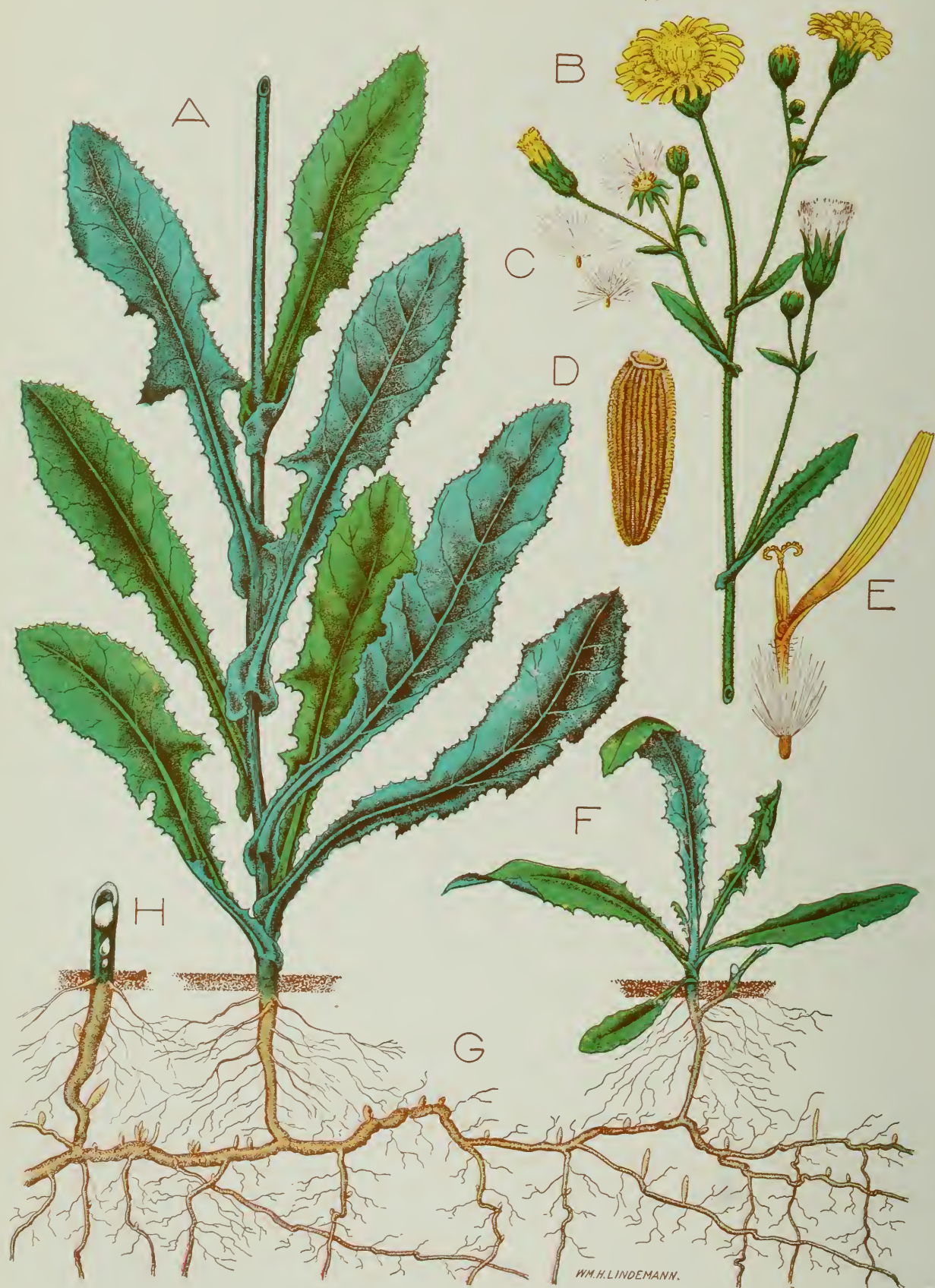


Plate 10.

plant is filled with a bitter milky juice. The leaves are from 4 to 12 inches long, deeply cut, with the segments pointing backwards (runcinate), slightly prickly. The flowers or, more correctly speaking, the flower-heads are deep orange-yellow in colour and 1½ inches or more across. They look somewhat like the flower-heads of the Dandelion. The involucre or flower cup and the peduncles or flower stems are covered with yellow glandular bristles. The seeds are dark reddish brown in colour, about 1/8 of an inch long, somewhat spindle-shaped with blunt ends, and each surface is deeply and closely ridged lengthwise, the ridges cross-wrinkled. Each seed bears a conspicuous tuft of white silky hair (pappus) which, when dry, acts as a parachute and makes it possible for the seed to be spread far and wide by the wind.

Time of flowering, June to August.

Time of seeding, July to October.

Dispersal: Chiefly by wind-borne seeds and running root-stocks.

POINTS OF DISTINCTION BETWEEN PERENNIAL SOW THISTLE AND THE ANNUAL SOW THISTLES

(1) The Perennial Sow Thistle is a taller and more slender plant than either the other two Sow Thistles.

(2) The Perennial Sow Thistle has numerous underground "roots," while the annual species have only tap roots (see illustrations).

(3) The leaves of the Common Annual Sow Thistle are deeply cut and lobed, and scarcely spiny. The leaves of the Spiny Annual Sow Thistle are wavy on the margin, prickly and often decidedly waxy. The leaves of the Perennial Sow Thistle are deeply cut, with the segments pointed backwards, and slightly prickly (see illustrations).

(4) The "flowers" of the Perennial Sow Thistle are deep yellow in colour and an inch and a half or more across, while the "flowers" of the annuals are pale yellow in colour and less than an inch in diameter.

(5) The "flower cups" (involucre) and flower stems (peduncles) of the Perennial Sow Thistle are copiously covered with short glandular bristles, while those of the annual species are nearly smooth.

GENERAL SUGGESTIONS FOR CONTROL

(1) Watch for the first patches of Sow Thistle in the field and destroy them before they become established.

(2) Be careful not to harrow or cultivate through patches and drag the underground "roots" all over the field.

(3) A few patches of Perennial Sow Thistle, if allowed to mature, may seed down a whole neighbourhood. Therefore take every precaution to prevent the seeding of patches in meadows, grain fields, fence corners and on the roadside.

(4) Cut the Sow Thistle to prevent it from seeding, just as soon as the first few "flowers" appear. Blossoms over five days old may develop viable seed after the plants are cut. Plants that have been cut off after coming into bloom will often produce shoots from the crown just above the ground, which come into blossom about a month after the first cutting. Thus a second cutting is necessary if the Sow Thistle is to be prevented from going to seed.

(5) Cultivating in dry weather is most effective in Sow Thistle control.

(6) It is a mistake to use a disc harrow in fighting Sow Thistle. This implement only cuts the running root-stocks into short pieces which are very difficult to bring up to the sun and which, if left in the soil, will produce new plants.

(7) Do not sow a field, which is badly infested with Sow Thistle, to grain. You will only waste your seed and time.

(8) Pasturing, while it may not kill Perennial Sow Thistle, holds it in check and prevents it from spreading. If possible, pasture every spot on the farm that is hard to control. If, in spite of pasturing, any Sow Thistle comes into bloom, cut it early to prevent it from seeding.

(9) Sheep are fond of Perennial Sow Thistle, and if turned on a field after harvest will prevent it seeding and by close cropping weaken the underground "roots."

(10) The Perennial Sow Thistle thrives most luxuriantly on rather low, damp land. Underdrainage, therefore, is a great help in controlling it.

(11) It is better to use low-lying undrained fields for pasture or hay rather than for grain crops.

(12) Crop rotation is of utmost importance in dealing with the Perennial Sow Thistle. Some sharp, short rotation of crops should be adopted which will allow for the frequent use of the cultivator during the dry weather of July and August, the cutting of the "flowers" before seeding, and the introduction of a smother crop or hoed crop.

(13) In summer fallowing for Perennial Sow Thistle, never let the thistle show above the ground. A bare or black fallow is the only effective one.

(14) Where soil fertility has been maintained by the judicious use of commercial fertilizers or well-rotted manure, the crop grows so vigorously that it appears to check the spread of the Sow Thistle.

CHEMICAL WEED KILLERS FOR SMALL PATCHES

Chemical weed killers, especially the chlorates, can be used effectively to destroy small patches of Perennial Sow Thistle. Their cost prohibits their use on large areas.

Small patches of Perennial Sow Thistle can also be destroyed by digging out the plants with a fork, roots and all, and burning them. Great care must be taken to get every bit of the "root." The patch should be watched, and if new shoots appear they should be taken out at once. In an ordinary season several diggings will be required in order to exterminate a patch.

DETAILED METHODS FOR THE CONTROL OF LARGE AREAS

No one method of control is best under all conditions. There are several methods which have been successfully employed, which will be dealt with here. All these methods aim at the destruction of the underground "roots," either by starving them by preventing leaf growth or drying and baking them by exposure to sun and air. The methods to be employed will depend chiefly upon the nature of the soil, the type of farming practised, the system of cropping that is being followed, and existing weather conditions. Each man concerned should choose that method of fighting the Perennial Sow Thistle that is known to be effective on his kind of soil and which can be adapted best to his particular system of farming.

THE DRY-CLEANING METHOD

This method has been found very effective when the Sow Thistle occurs on heavy clay soils, where it is extremely difficult to control. The following are the directions:

Plow in July while it is dry. Take off the hay one week earlier than usual and start plowing the meadow at once. Plow six to seven inches deep, preferably with a two-furrowed tractor plow with ten-inch bottoms (only), sharp shares and coulter. Three-bottom plows or twelve-inch plows are not generally practical for hard, dry soil. Have the plow adjusted properly.

After the land is dry-plowed, it will be very roughly set up, with large clods and lumps and holes everywhere in evidence. These newly plowed lands should not be touched for a week or more, depending on weather conditions. After some days of exposure to the sun, and while the weather is still hot and dry, start to cultivate and give steady and repeated cultivation as long as the weather remains dry.

Tractor or four-horse cultivators, first with narrow teeth and finally with broad teeth, should be used. The heavier the land the heavier the machinery must be to crack the hard soil and break the lumps in dry weather. The tractor has the advantage of speed, and speed cracks the lumps with little difficulty. This method dries out and severely weakens the Sow Thistle "roots" so that subsequent cultivation kills them.

THE RAPE METHOD

Immediately after harvest gang-plow shallow and run over the field several times with a broad-share cultivator. Later in the fall plow a little deeper, and continue cultivation every week or ten days as long as the season permits. Last thing before the ground freezes rib up the land with a double mould-board plow. In the spring work down the ridges and cultivate the field until about the middle of June, running over it frequently with a cultivator so as to keep the tops down and weaken the "roots." Then apply manure at the rate of about twenty tons per acre (twelve good loads). Cultivate the manure in thoroughly, and with a double mould-board plow slightly ridge up the land, making the ridges about twenty-six inches apart. On the ridges sow pasture rape (Dwarf Essex variety) at the rate of $1\frac{1}{2}$ lbs. per acre. It is important that the right amount of rape should be sown, for if too little is sown the stand will not be thick enough to smother the weeds, and if, on the other hand, too much is sown the plants will be too crowded and not grow vigorously enough to keep ahead of the Thistle. Sow the rape when the land is sufficiently moist to insure quick germination of the seed. If the rape is slow in starting, the Sow Thistle may get a start in the rows and thus necessitate hand cultivation there. Cultivate the rape every week or ten days until it occupies all the ground and makes further cultivation impossible. This method requires considerable labour, but it is profitable labour, as it is very effective. Nearly all our co-operative weed experimenters who have tried this method have found it most satisfactory. Many men hesitate to use rape. This is perhaps because they are not familiar with its agricultural value. Rape has a high feeding value for sheep, hogs and fattening cattle. It is used chiefly for pasture and to some extent as a soiling crop.

SHORT ROTATION OF CROPS

Follow clover by a crop of grain, then clover again. Cut the first crop of clover in June and plow the land about six inches deep. Let it lie in the rough for about two weeks during hot weather. Then give frequent and thorough cultivation with a cultivator with broad points during the rest of the summer except during wet weather. The following spring sow a grain crop, seeding down with clover. For best results the grain crop should be barley or early oats, which can be cut early enough to prevent the Thistle from seeding. The advantage of this system is that it allows of frequent and thorough cultivation during the hottest and driest part of the summer when cultivation is most effective in the destruction of Perennial Sow Thistle.

Another excellent short rotation with which to fight Sow Thistle and other perennial weeds is outlined on page 5.

A BLACK SUMMER FALLOW

This may be started in the spring or fall. If a field which has been in grain is overrun with Sow Thistle, it is often advisable to start the summer fallow in the fall. Directly after harvest plow the land about six inches deep, and then give frequent

cultivation at regular intervals as long as the season permits with a broad-share or spring-toothed cultivator. The following spring gang-plow the land and keep in bare summer fallow until it is time to sow fall wheat. The summer fallow, to be effective, must be a bare or black fallow. The field must be cultivated thoroughly and frequently enough to keep the Sow Thistle from making any growth above ground. In starting a black fallow in the spring, cultivation should begin as early as possible and continue at regular intervals as described above until late fall, when the field should be plowed and left in the rough state over winter. The following spring, thorough cultivation at repeated intervals should be given until seeding time. Then early-maturing varieties of grain should be sown, seeding down with clovers. Early varieties of oats and barley mature ten to twelve days earlier than the late varieties. This is an important factor in the control of Sow Thistle, as the grain can be cut before most of the Sow Thistle has a chance to mature seed, and after-harvest cultivation can be started sooner. Bare summer fallow has given excellent results in seasons when other methods were only partly effective. In an average season such summer fallows as described above can be depended upon to destroy Sow Thistle. In a very wet season, however, no such method is entirely effective. Summer fallowing for the whole season is often objected to because it is costly. A season's crop is lost, much labour is required, and valuable plant food materials are leached from the soil. It is often better therefore to resort to a black summer fallow for only a portion of the season, either before putting in a hoed crop or smother crop such as buckwheat, rape or sweet clover, or immediately after breaking up meadows or pastures. Many men are using sweet clover to fight Sow Thistle. They cut it for the silo in June, then plow the field and keep it under bare fallow until it is time to put in fall wheat. They claim that this is an effective way of fighting Sow Thistle.

WINTER RYE AND BUCKWHEAT OR ROOTS

As soon as the grain crop is harvested, plow the land and give frequent cultivation with a cultivator with broad points until the first or middle of September. Then sow winter rye at the rate of about two bushels per acre. This can be pastured the following spring or cut for hay or grain. As soon as the rye is off the land, plow about four inches deep. Then cultivate thoroughly and put in rape, buckwheat, or even turnips. The advantage of this system is that three crops are harvested in two years and the Sow Thistle fought at the same time. This method can be used successfully on all except the heavier types of clay soils. Buckwheat is one of the best smother crops that can be used in the control of Sow Thistle.

UNITED ACTION REQUIRED

Many of the best farmers of the Province are fighting Perennial Sow Thistle successfully. Their battle with it, however, is made much more difficult because some men in every neighbourhood are neglecting it and allowing it to go to seed. Millions of plants are allowed to go to seed each year in Ontario, and their billions of seeds are scattered far and wide by the wind. Is it any wonder that even some of our best farmers are becoming discouraged by the inroads of the Perennial Sow Thistle? United action is imperative to overcome this menace to Ontario agriculture. Every farmer who has Perennial Sow Thistle on his farm should realize his obligation to his neighbours and himself, and give this weed at least enough attention to prevent it from going to seed.

Common Annual Sow Thistle, or Milk Thistle (*Sonchus oleraceus*, L.)—Fig. 58

An annual weed introduced from Europe. It grows 2 to 3 feet high, has fibrous roots and leafy stem, and is not quite so large or coarse as the Perennial Sow Thistle. The leaves are much lobed, and have short, soft spines. Each head is many-flowered,

but the "flowers" are small, about $\frac{1}{2}$ of an inch across, and of a pale yellow colour. The seeds are brown, dull or roughened, and about $\frac{1}{8}$ of an inch long, with five longitudinal ridges finely wrinkled crosswise, and attached to the top is a large tuft of fine hairs united at the base.

Time of flowering, June to August.

Time of seeding, July to August

Dispersal: Chiefly by the wind.



Fig. 58. Common Annual Sow Thistle (*Sonchus oleraceus*).

Control. Prevent it from seeding in waste places by frequent cutting or by cleaning up such places and seeding them to permanent grasses. After-harvest cultivation and a rotation of crops will soon cause this weed to disappear from cultivated fields.

Spiny Annual Sow Thistle (*Sonchus asper*, L., Hill)—Fig. 59

Very similar in habit and general appearance to the Common Annual Sow Thistle. It can be easily recognized by its more prickly and less deeply cut leaves. The seed is very similar to that of the preceding species in colour, shape and size, but distinctly three-nerved on each face with the nerves and inter-spaces smooth.

Control. Same as for preceding species.

Prickly Lettuce (*Lactuca scariola*, L.)—Fig. 60

Prickly Lettuce is a native of the Old World, and has invaded this Province both from New York and Michigan. It is a winter annual; it springs from seeds in the fall and survives the winter. The plant grows to a height of $3\frac{1}{2}$ feet; the stem is leafy and usually smooth; the leaves are oblong and slightly pointed, often clasping at the base; the under surface of the midrib of the leaf is spiny; heads are numerous and yellow.

Time of flowering, July to September.

Time of seeding, August to October.

Dispersal: By means of its seeds, which are provided with a pappus or tuft of hair. An ordinary plant may produce 8,000 seeds.

Control. The best methods of destroying the weeds are: (1) To mow repeatedly as it comes into bloom, or earlier. (2) To cultivate thoroughly with a hoed crop. By this method the seeds in the soil will be induced to germinate. They should not be covered deeply in plowing. Mature plants should be cut down and burned lest the seeds be blown about and scattered by the wind.

Farmers should be careful to buy only clean clover, millet and grass seeds; and the weed inspector should insist on the fulfilment of the law, and have all fence corners, roadsides and waste lands cleared of the pest.

Wild Lettuce, Southern Thistle, or Trumpet-Milkweed (Erroneously called Prickly Lettuce) (*Lactuca canadensis*, L.)

An annual or biennial plant with a leafy stem, which may attain a height of 7 feet. The leaves are deeply lobed, terminating in an acute point, and have stalks or petioles, the lower ones being smaller than those near the top of the stem. The stem branches at its summit into a compound flower-cluster. The "flowers" are small, yellow in colour, and open only a few at a time. The seed is dark brown in colour, flat and oval, with longitudinal ribs and thread-like beak at the apex, and possesses a small white tuft of hair.

Time of flowering, June to October.

Time of seeding, July to October.

Dispersal: Chiefly by the wind.

Control. Where there is not much of it, pull and burn before ripening. Where this cannot be done, use the same method of cultivation as for Mustard.



Fig. 59. Spiny Annual Sow Thistle (*Sonchus asper*).



Fig. 60. Prickly Lettuce (*Lactuca scariola*).



Fig. 61. Paint Brush (*Hieracium aurantiacum*).

Paint Brush, Devil's Paint Brush, or Orange Hawkweed (*Hieracium aurantiacum*, L.)

This is a weed which is causing much damage to permanent pastures in many parts of Ontario. It grows rapidly and soon crowds out the grass in pasture lands. It is especially serious in meadows and pastures which cannot be broken up and brought under a crop rotation. Each year it is becoming more widespread and invading new areas of the Province.

Description. It is a perennial weed of European origin. It has numerous shallow-rooted, creeping root-stocks. The leaves are basal and lie close to the ground, forming a rosette. They are broadly lance-shaped, from 2 to 6 inches in length. The "flowers" are orange-red in colour, about $\frac{2}{3}$ of an inch in diameter, and borne in clusters on the top of a simple, nearly leafless stem, from 12 to 18 inches high. Ripe seeds are dull jet black in colour; unripe seeds, deep red. They are torpedo-shaped, about $\frac{1}{12}$ of an inch long and ribbed lengthwise. They have at the top a tuft of hair, which, however, is usually absent when the seed is found in clover seed.

Time of flowering, June.

Time of seeding, seeds ripe by July.

Dispersal: By seeds and creeping stems.

Control. Paint Brush is but a shallow-rooted perennial and readily succumbs to cultivation. Infested meadows and pasture lands should be broken up and put under a short rotation of crops. In rocky and upland pastures which cannot be plowed, small patches of Paint Brush can be destroyed by spraying with a chemical weed killer without permanent injury to the grass. Coarse salt applied at the rate of 18 to 20 lbs. per square rod is recommended for the control of this weed. Infested permanent pastures often may be improved by sowing a good permanent pasture mixture and by the judicious use of commercial fertilizers.

King Devil (*Hieracium praealtum*, Gochnat, var. *decipiens*, Koch)

This is another pasture and meadow weed. It is troublesome chiefly in Eastern Ontario. It has the general characteristics of Orange Hawk Weed, from which it can be distinguished by the small yellow flower-heads and by the fact that the whole plant is sparsely hairy and lightly covered with a fine bloom.

Control. Treat the same as Orange Hawk Weed.

KNOW THE WEEDS

It is very important that those engaged in farming should get to know the worst weeds and the weed seeds most frequently found in commercial seeds. This they can do with a little trouble. Strange weeds should be sent to the Botanical Department, Ontario Agricultural College, Guelph, for identification, and a collection of the most common weed seeds should be secured for reference and comparison.

WEED IDENTIFICATION AND SEED TESTING

The Department of Botany is at the service of farmers, gardeners, seed merchants and others in the identification of weeds, weed seeds, plant diseases, grasses and economic plants. Clover and other farm seeds are tested and reported upon as to purity free of charge. Plant specimens and samples of seeds should be carefully packed and addressed with postage prepaid to the Botanical Department, Ontario Agricultural College, Guelph, Ontario.

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TORONTO, ONTARIO

PROFITS FROM FERTILIZING FARM CROPS

(The Results of a Twenty-four Year Experiment)

BY

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and

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A Testing Ground for Fertilizer Studies

DEPARTMENT OF FIELD HUSBANDRY

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In 1914 an experiment was laid down on the field crop trial grounds at the Ontario Agricultural College, the object of which was to study the value of certain ready-mixed commercial fertilizers then on the market, in comparison with home-mixed fertilizers and with barnyard manure alone and supplemented by commercial fertilizer. Because of a current opinion that only the crop to which the manure or commercial fertilizer was applied benefited by its use, it was planned to have this experiment include a four year rotation of crops (potatoes, barley, oats, and red clover), and to apply the fertilizer only to the potato crop, and therefore only once in the four year rotation. The residual effect of the fertilizers could thus be determined for each succeeding crop. The rotation was repeated six times in the twenty-four years. (See footnote on last page.)

THE LAYOUT OF THE EXPERIMENT:

The layout is made clear by the accompanying diagram. The four sections differ in their treatment only in the composition of the commercial fertilizer applied.

The whole area was planted each year to a common crop as follows:—the first year potatoes, to which the fertilizer was applied; the second year barley; the third year oats, seeded down with red clover; and the fourth year red clover hay. The aftermath of the red clover crop was plowed under in the fall in preparation for the succeeding potato crop.

The exact ratios of nitrogen, phosphorus and potash varied in the commercial fertilizers applied to the different sections. The tendency was to have a slightly higher phosphorus ratio in section A than in section B, and to have a slightly higher potash ratio in section D than in section C. At the end of sixteen years a change was made in the composition of the fertilizers used, but the foregoing tendencies with regard to the ratios of phosphorus and potash were maintained.

PLAN OF EXPERIMENT

SECTION "B"

20 tons manure
10 tons manure + 320 lbs. commercial fertilizer
960 lbs. commercial fertilizer
640 lbs. commercial fertilizer
320 lbs. commercial fertilizer
No fertilizer

SECTION "C"

No fertilizer
320 lbs. commercial fertilizer
640 lbs. commercial fertilizer
960 lbs. commercial fertilizer
10 tons manure + 320 lbs. commercial fertilizer
20 tons manure



SECTION "A"

W ← → E

SECTION "D"

20 tons manure
10 tons manure + 320 lbs. commercial fertilizer
960 lbs. commercial fertilizer
640 lbs. commercial fertilizer
320 lbs. commercial fertilizer
No fertilizer



No fertilizer
320 lbs. commercial fertilizer
640 lbs. commercial fertilizer
960 lbs. commercial fertilizer
10 tons manure + 320 lbs. commercial fertilizer
20 tons manure

THE RESULTS SECURED:

There were no significant differences between the yields of sections A, B, C, and D as a whole. This indicates that the various compositions of fertilizers used were about equally effective in influencing the yields of the crops to which they were applied. This being the case it was decided to average the results from all four sections in computing the final figures for yields and profits.

At the end of the twenty-four year period each crop had been grown six times and the average yields for the six crops were used in all cases.

TABLE 1
Average Yields of the Crops
Grown with the Different Treatments
(6 Yr. Ave. of each Crop)

Treatment	Bus. per Acre			Tons per Acre
	Potatoes	Barley	Oats	Red Clover
Unfertilized	93.13	26.22	49.33	2.24
320 lbs. commercial fertilizer	125.39	30.85	53.06	2.47
640 lbs. commercial fertilizer	143.17	34.40	52.24	2.68
960 lbs. commercial fertilizer	156.25	39.19	55.37	2.92
10 tons manure+ 320 lbs. commer- cial fertilizer	218.13	47.45	56.97	3.50
20 tons manure	221.38	52.33	56.80	3.82

Table 1 presents some interesting results. In every case the unfertilized plots are decidedly the lowest yielding.

With one exception, that of oats receiving 640 lbs. of commercial fertilizer, there has been an increased yield with the increasing quantities of commercial fertilizer. The question of the profitableness of this increase will be discussed later.

The fact that succeeding crops, as well as those to which the fertilizer was applied, profited by the application is very definitely indicated. Each crop in the rotation shows a definite increase over the unfertilized plot. The practice of charging around sixty percent of the value of a fertilizer to the crop to which it is applied seems to be borne out by the results presented.

One of the most significant facts is the largely increased yield secured when barnyard manure is used either alone at twenty tons per acre or at half the quantity supplemented with 320 lbs. of commercial fertilizer. The manure used in this experiment was not different in any way from that available on most farms. Some available source of organic matter seems highly desirable if best results are to be secured from commercial fertilizers of any kind.

PROFITS FROM THE DIFFERENT TREATMENTS:

It is not sufficient to secure increased yields by the application of fertilizers to crops. These increases must be secured at a profit. Table 2 presents the increased yields valued at a reasonable price and balanced against the increased cost of securing the additional plant food.

(For Table 2, See Page 7)

A forty-seven year average price should be a reasonable figure at which to compute the value of the increased yields of the various crops. The average cost of the commercial fertilizer during the duration of the experiment is decidedly higher than present day prices. This fact tends towards a conservative rather than liberal interpretation of profits.

Not only has a decided increase in yield been secured during the twenty-four years of the experiment but this increase has been secured at a gratifying profit. This profit is not confined to a single crop but is experienced in each crop of the rotation.

By far the most profit was secured when barnyard manure was used alone or supplemented by 320 lbs. of commercial fertilizer. These results would suggest the possibility of securing additional profit from farm crops by spreading the applications of barnyard manure over larger acreages and supplementing this lighter application with the proper quantities of suitable commercial fertilizers.

The practice of selling manure off the farm and trying to keep up fertility by means of commercial fertilizers would appear to be poor economy. The manure is badly needed to enable the farmer to get the best results with commercial fertilizers.

A FEW CONCLUSIONS:

All rates of application of fertilizer used paid profits.

Increasing the rate of application appeared to increase the profit.

The beneficial results of the fertilizers were spread over all four crops in the rotation.

About two-thirds of the cost could reasonably be charged to the potato crop to which the fertilizer was applied.

The use of twenty tons of barnyard manure alone, or half that amount supplemented by 320 lbs. of commercial fertilizer, was decidedly the most profitable.

Selling barnyard manure off the farm is poor economy.



FOOTNOTE:

The soil on which this experiment was carried out is classified as Guelph loam. It is nearly neutral in reaction and has good natural drainage. It is well supplied with lime, medium to low in organic matter, low in available phosphate, and medium to low in available potash. This soil type is representative of a large portion of central southwestern Ontario.

T A B L E 2

SUMMARY TABLE OF PROFITS WITH BARNYARD MANURE AND COMMERCIAL FERTILIZERS
OVER A TWENTY-FOUR YEAR PERIOD

Treatment (Every 4 Years)	Cost of Fertilizer One Application in 4 yrs.	Average Excess Yields per Acre and Value per Acre over Unfertilized in a 4-Year Period								Increase Revenue Over Un- fertilized Plot from 4 Crops	Net Profit per Acre From 4 Crops During the 4-year Period
		Potatoes		Barley		Oats		Red Clover			
		Yield Bus.	Value \$	Yield Bus.	Value \$	Yield Bus.	Value \$	Yield Tons	Value \$		
I. Unfertilized	0	0	0	0	0	0	0	0	0	0	
II. 320 lbs. Commer- cial Fertilizer	\$ 6.72	32.26	\$18.56	4.63	\$ 2.68	3.73	\$ 1.56	.23	\$ 2.52	\$25.32	\$18.60
III. 640 lbs. Commer- cial Fertilizer	13.44	50.04	28.79	8.22	4.76	2.91	1.21	.42	4.64	39.40	25.96
IV. 960 lbs. Commer- cial Fertilizer	20.16	63.12	36.32	12.97	7.51	6.04	2.52	.68	7.45	53.80	33.64
V. 10 tons Manure + 320 lbs. Commer- cial Fertilizer	21.72	125.00	71.93	21.26	12.31	7.64	3.19	1.26	13.81	101.23	79.51
VI. 20 tons Manure	30.00	128.25	73.80	26.11	15.12	7.47	3.12	1.58	17.32	109.35	79.35

Average of 96 Tests.

VALUE OF CROPS BASED ON A 47-YEAR AVERAGE OF PRICES FOR ONTARIO

Potatoes	57.5c per bus.	Clover Hay	\$11.00 per ton
Barley	57.9c per bus.	Barnyard Manure	\$ 1.50 per ton
Oats	40.7c per bus.	Commercial Fertilizer	\$42.00 per ton

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TORONTO, ONTARIO

CURING EARLY-CUT HAY ON TRIPODS

BY

O. McConkey, B.S.A., M.S., Ph.D.



ONTARIO AGRICULTURAL COLLEGE

GUELPH, ONTARIO

CURING EARLY-CUT HAY ON TRIPODS

BY

O. McConkey, B.S.A., M.S., Ph.D.

FIELD HUSBANDRY DEPARTMENT

There is a growing demand in Ontario for information on the making of hay **sweeps** and **tripods** for curing **early-cut hay**, and saving **hay or second-cut alfalfa** in **wet weather**.

The Value of Early-cut Hay

1. A supply of high quality early-cut hay cuts down on feed bills.
2. Early-cut hay is more **leafy, palatable, and digestible** than late-cut hay.
3. It is high in protein (15% to 22%), vitamins, and available minerals.
4. Experimental work has shown that an acre of Timothy cut in the **early bloom stage** yielded **98 lbs. of digestible protein** over an acre cut in the **late seed-forming** stage. This is equivalent in terms of **digestible protein** to **293 lbs. of oilcake, worth approximately \$5.86, or 28 bushels of oats**.
5. The experiment showed that **1 acre of early-cut hay was equivalent** in digestible protein to **2.3 acres of late-cut hay**.
6. This leafy, soft hay makes excellent feed for cattle, especially calves and milking cows. A dairyman in Oxford county found that his herd production dropped from 12 to 9 cans of milk per day when he stopped feeding early-cut, tripod-cured hay.
7. This method of curing lowers danger of barn fires from spontaneous combustion.
8. **Aftermath** grows **quickly** after early-cut hay, and **furnishes pasture in July and August** when it is most needed.
9. Early cutting of hay controls weeds.

Care of Hay Meadow in the Fall

1. Do not graze or cut a hay meadow too closely in the fall; be careful to leave a **vigorous leafy top over the hay field in September** so that the plants can store up food in the roots and so curtail **winter killing**.
2. It is a good plan to topdress hay meadows in September with a light dressing—4 to 5 tons of well-rotted manure reinforced with phosphate.



*Leafy green hay, 18.9% protein. Farm of Alex Stewart, Ailsa Craig.
 "Feed it and see the results."*

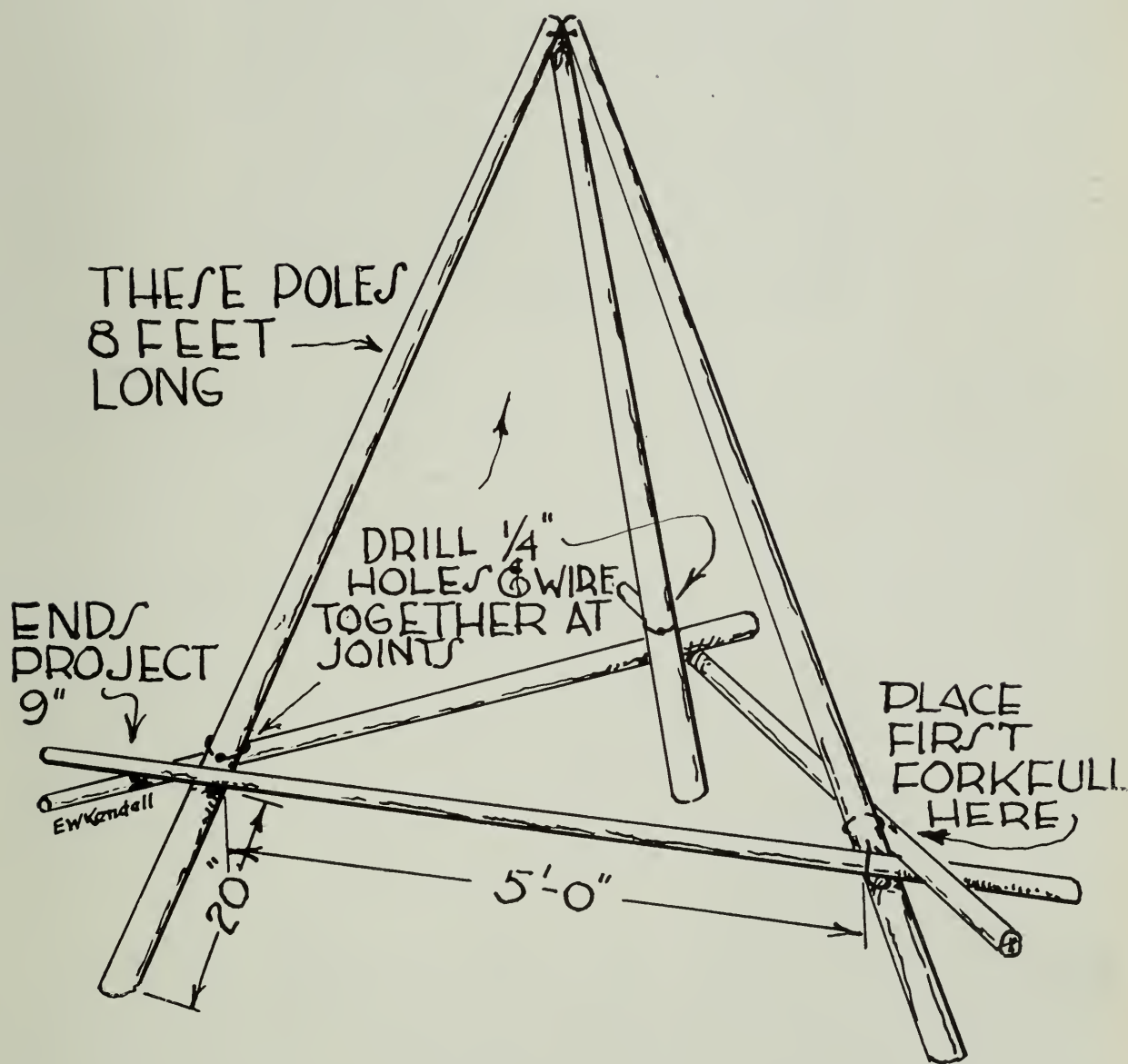
STAGE OF CUTTING FOR BEST-QUALITY FEED

<i>Timothy</i>	<i>Early bloom stage</i>
<i>Alfalfa</i>	<i>Tenth bloom stage</i>
<i>Red Clover</i>	<i>Half to full bloom stage</i>

How to Use Tripods

1. Cut a portion (about 25%) of your hay in the bud and early bloom stage. This will give **high quality hay**, and the **aftermath** from this area can be fenced off by **electric fence** and used for pasture in July and August.
2. Leave hay in swath until **wilted**, but not dry and brittle enough to **lose the leaves**.
3. Use a pushsweep or rake to collect the hay near the tripods.
4. Hay may be left on the tripods for two weeks, enabling you to cut the rest of the crop nearer the right time.
5. Use 7 to 10 tripods per acre, according to the crop.
6. 1200 to 1400 lbs. green hay per tripod—pile in a **cone shape** to turn water.
7. Leave holes in the skirt of hay at the ground to let the air circulate underneath and up through the hay.
8. Comb down the sides to shed water.

TRIPOD FOR EARLY CUT HAY





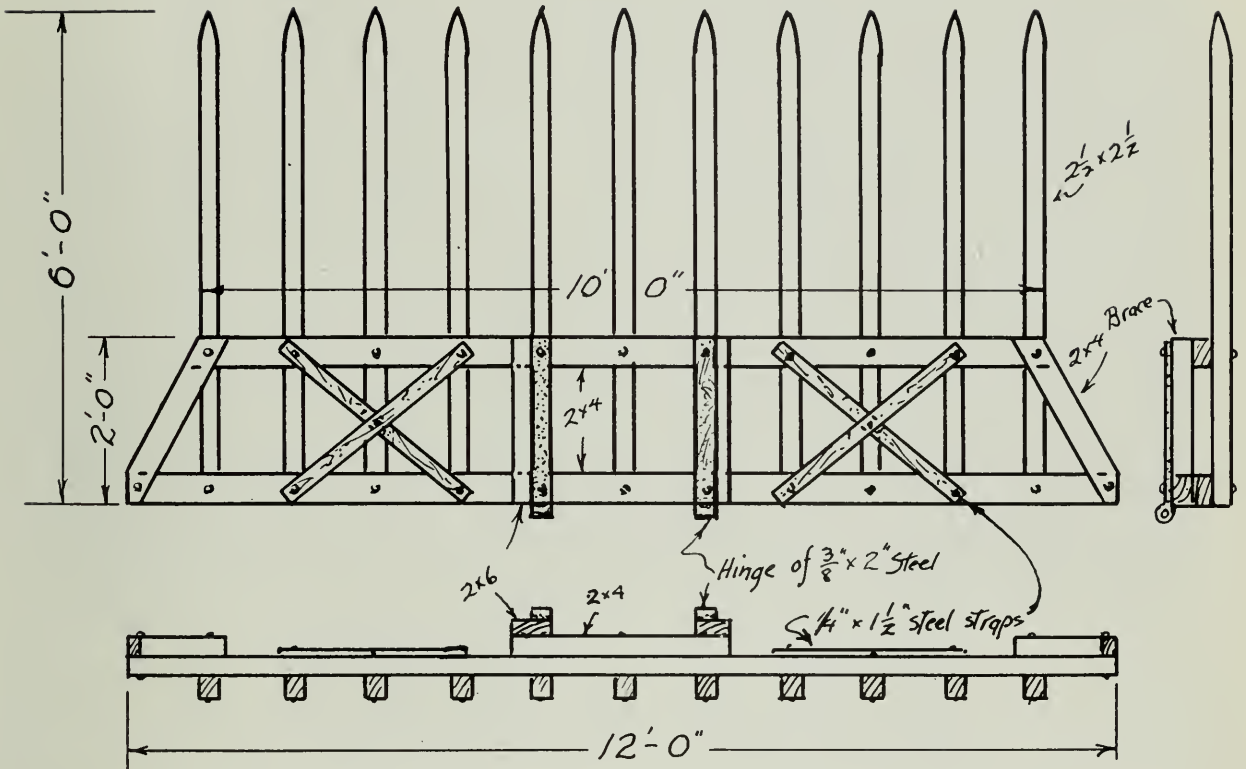
Materials

1. Cedar poles, 8 feet long, not less than $2\frac{1}{2}$ inches at small end; wire together at top through small auger holes.
2. Crosspieces, 7 feet long, projecting 9 inches at corners to hold **first** forksful.
3. Secure crosspieces at intersections with No. 9 wire loop, large enough for free play of crosspieces when erecting.

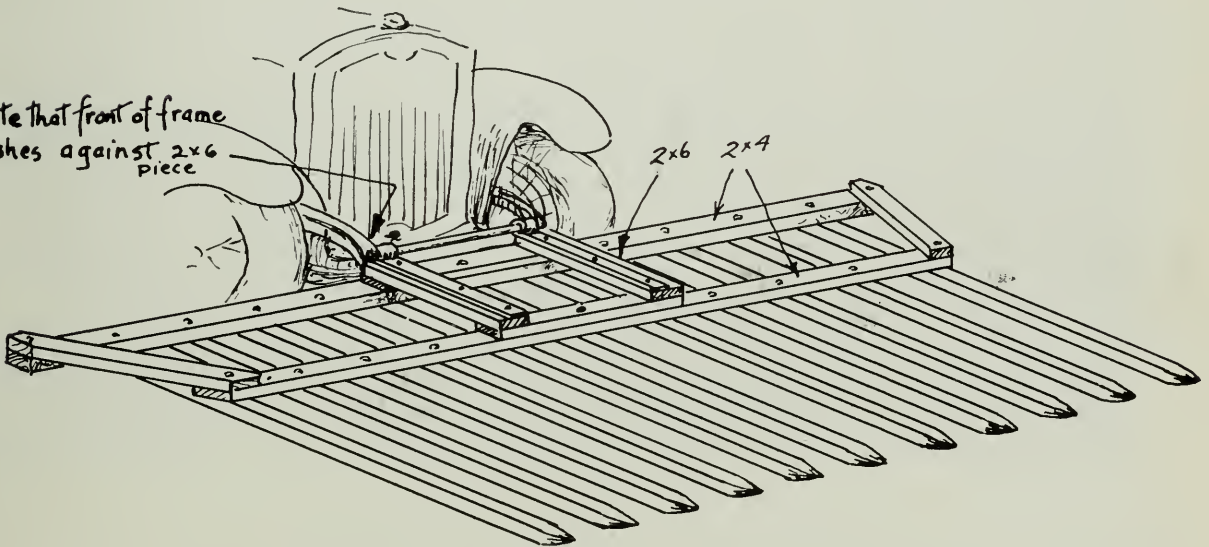


Crop of Alfalfa cured on tripods. Douglas Bros., Vinemount, Ontario.

SWEEP RAKE



Note that front of frame
pushes against 2x6
piece





Sweep attached to tractor.

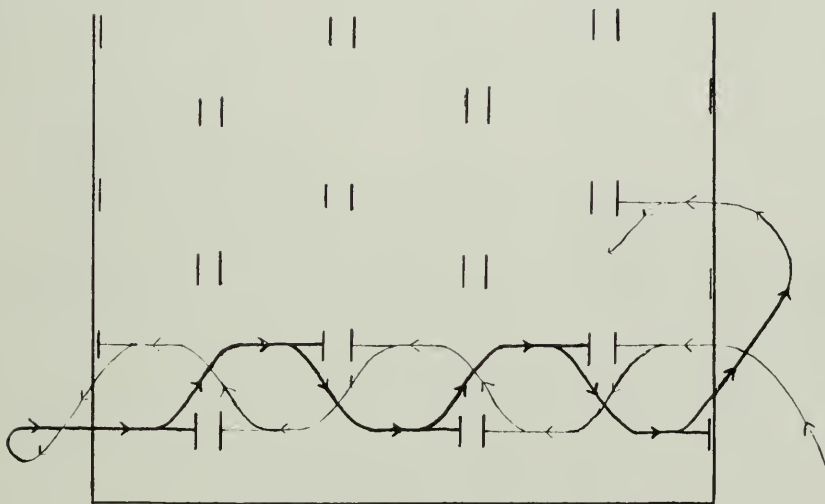


Ready for travelling.

NOTE: The corner wheels are from a side-delivery rake. These wheels are not necessary if the sweep is attached to the tractor at a lower angle.



Sweep attached to car.



METHOD OF SWEEPING A FIELD:

Faint lines show the first trip up the field. Dark lines show the return trip. Bunches are left in rows convenient to the tripods.



*Second-cut Alfalfa.
Saved, Experimental Farm, Ridgetown.*



*Second-cut Alfalfa.
Destroyed, Bruce County.*

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Statistics and Publications Branch

TORONTO, ONTARIO

QUICK FROZEN FRUITS AND VEGETABLES IN LOCKER STORAGES

BY

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Department of Horticulture

ONTARIO AGRICULTURAL COLLEGE

Guelph, Ontario

QUICK FROZEN FRUITS AND VEGETABLES IN LOCKER STORAGES

BY

J. H. L. TRUSCOTT, Ph.D.

QUICK-FROZEN FRUITS AND VEGETABLES

The preservation of certain fruits and vegetables by quick-freezing provides a food product which is highly attractive in appearance and which often approximates closely the flavour and aroma of the fresh product.

The rapid growth of the locker-storage business has made it necessary to place in the hands of housewives information on the processing and use of frozen fruits and vegetables. This bulletin is written for her guidance. Lack of proper knowledge has already caused too many disappointments in connection with these products and the housewife is advised to follow closely the simple procedures contained herein. It is quite possible for the housewife to produce a really good product when she has access to a locker storage with adequate facilities.

THE USE OF QUICK-FROZEN FRUITS AND VEGETABLES

Warning

Fruits or vegetables, particularly the latter, which have been preserved by freezing are highly perishable commodities when the frost has been removed. They are **not sterilized** as they are when they are canned, and moulds and bacteria will develop readily in the defrosted product. In addition to "spoilage" as a result of the activity of moulds and bacteria, the flavour, odour, appearance and desirable texture are lost rapidly after defrosting. A decidedly unpalatable or even harmful product may result from the use of frozen fruits and vegetables which have been allowed to thaw and are not consumed or cooked within a few hours after the frost has been removed.

1. Frozen fruits should be thawed in their containers and kept chilled and unopened until required for the table. Use them in the same manner as fresh fruit.

2. Frozen vegetables should be thawed sufficiently to remove the frozen mass from the container and then dropped into boiling water for cooking.

3. Cook the vegetables sufficiently to be palatable. It will require a much shorter cooking time than the fresh product. They have already been scalded, and freezing softens the tissues still further. Five minutes of actual boiling is usually enough. Sufficient water should be added to the brine in which the vegetable was packed to cover the vegetable in the cooking vessel.

4. A few layers of newspaper will hold ice in a frozen package during most of a day at ordinary room temperatures. If the product is needed immediately, put the package in a warm place or drop it into water.

VARIETIES SUITABLE FOR FREEZING

There are dozens and sometimes hundreds of varieties of each fruit and vegetable and only a very few varieties will make a suitable quick-frozen product. Some varieties are so unsuited as to be practically inedible after they are frozen. During the past five years most of the commoner varieties of both fruits and vegetables have been tested and while new ones are appearing constantly the housewife is not likely to discover a variety better than those recommended.

PACKAGES

There are two methods of packing fruits and vegetables. The first is known as "wet-pack" and this means that the fruit is covered with a syrup made from sugar and water or a syrup made from sugar and the juice of the fruit itself; or, vegetables are covered with a mixture of water and a small amount of table salt. The second is known as "dry-pack" and in this pack the fruit or vegetable is placed in a container and frozen without a liquid covering. Obviously any package designed for wet-pack materials must be water-tight. It is not so obvious but just as important that the package used for dry-pack must be vapour-proof. This latter package must be of such a nature that there is little or no loss of moisture from the product during storage. A freezer room is ordinarily a very dry room and unprotected frozen products can be ruined in a comparatively short time by evaporation.

New wrapping materials and packages are appearing on the market constantly. Many of these packaging materials depend on wax to make them water-vapour-proof. Ordinary light wax-paper is usually not sufficient protection. Heavily waxed cardboards and papers are usually considered satisfactory. A type of moisture-proof, heat-sealing cellophane has been found useful as a wrapping material. Regardless of the type of package or wrapper, it is necessary to seal carefully all joints. Glass jars, particularly straight-sided jelly

jars, make excellent containers for frozen fruits and vegetables. They are usually available in a kitchen but they have the disadvantage that they tend not to pack tightly together and therefore waste some space in the locker.

Regardless of the type of package and when wet-pack is being used, allowance must be made for expansion during freezing. Usually leave about one-tenth of the container not filled.

METHOD OF PACKING

The difference between dry-pack and wet-pack has already been described. Most vegetables may be frozen in either wet- or dry-pack but we prefer the wet-pack. This pack has the commercial disadvantage of adding to transportation costs on account of the extra weight, but this can hardly be considered an important factor as far as locker storage is concerned. It is true also that a wet-pack may take longer to freeze than a dry-pack and there is evidence that the vegetable tissues are more disorganized when frozen in the wet-pack. The wet-pack has the advantage that it provides a reserve of refrigeration after the product is removed from storage and we believe that the flavour is better than in dry-pack.

With very few exceptions fruits are better in a wet-pack. Those exceptions will be noted later.

SPEED IS ESSENTIAL

The aim in the quick-freezing method of preservation is to capture and hold as much as possible of the food value, appearance, texture and flavour of top-quality fruits and vegetables. These products tend to lose at least some of these desirable qualities rather quickly after they are harvested. Speed is just as essential in keeping down the number of moulds and bacteria which may cause spoilage. It is the housewife's responsibility to prepare the products and deliver them to the storage in as short a time as possible. It is the responsibility of the storage operator to see that facilities are available for quick freezing. If there is no sharp-freezer room available it is better to freeze the packages on open shelves or tables in the locker room than in the locker itself. Scatter the packages so that each one has good contact on all sides with the freezing air. An electric fan blowing cold air at the packages will increase the rate of freezing. After the packages are frozen completely they are removed to the locker for storage. The recommended temperature for freezing fruits and vegetables is 0° F. or lower. The recommended storage temperature is 0° F. or lower and it is advisable to keep the storage temperature constant.

FRUITS

Syrups

The amount of sugar to be used in the syrup depends partially on individual taste. A light syrup (of about 25% sugar and 75% water by weight) is effective in helping to preserve the appearance and flavour in fruits. Stronger syrups may be used but in our opinion they tend to mask the desirable flavour of the fruit itself. When dry sugar is added to whole, crushed, or sliced fruit, the proportions again are partially a matter of taste. A mixture of 2 parts of fruit to 1 of sugar by weight is very sweet. A six-to-one mixture is usually strong enough to protect the appearance and the flavour of the fruit. When dry sugar is used it must be allowed to form a syrup with the fruit juice and be mixed evenly through the mass of fruit.

General Procedure for Fruits

1. Harvest when full ripe.
2. Wash thoroughly in clear water.
3. Cull and grade for size.
4. Pack in containers.
5. Cover with cold syrup.
6. Freeze at 0° F. or lower.
7. Store at 0° F. or lower.

Apricots

Not many apricots are grown in Ontario but a few are available. **Hilton** made a satisfactory pack when halved and covered with a 25% syrup.

Blackberry

Blackberries need to be completely ripe before freezing, otherwise they develop a red colour and are very sour. **Lowden** is recommended in 25% syrup. It is reasonably good in a dry-pack.

Black Raspberry (Black Caps)

Seedling No. 371 (G. Adam's) packed in 25% syrup is the best variety tested thus far. Most varieties give a reasonably good pack when slightly crushed and mixed with sugar (4 parts of berries to 1 of sugar by weight).

Cantaloupe

Only two varieties, **Sugar Salmon** and **California**, have been tested. The edible portion was cut into half-inch cubes and frozen both as dry-pack and in 25% syrup. Both varieties and both methods of packing were satisfactory.

Cherries, Sour

The two common varieties, **Early Richmond** and **Montmorency**, are satisfactory. Harvest when fully mature. Wash and pit. Since sour cherries

are ordinarily cooked and a syrup pack would provide too much liquid they are best packed with sugar in the proportions needed for pies, etc. Freeze after the sugar is dissolved. This is an excellent product.

Cherries, Sweet

All of the light-coloured varieties have the tendency to become brown when removed from the covering syrup. The flavour is only fair. **Victor** makes an attractive looking frozen product and is reasonably good in texture and flavour when pitted and packed in 25% syrup.

Several of the black cherries provide a reasonably good pack in 25% syrup when pitted. Among these are **Hedelfingen, Lambert, Schmitz Bigarreau, Black Eagle** and **Black Tartarian**. **Velvet** freezes with good quality when packed whole without removing stems or pits and without syrup or sugar (dry-pack). It should be dropped into cold water for about five minutes to remove the frost and eaten as a fresh cherry within half an hour.

Blueberries

Blueberries have not been tested here but are said to provide a good frozen product in either syrup or dry-pack.

Currants

Prepare currants as for immediate use and freeze in 25% syrup. All varieties tested were reasonably satisfactory.

Cranberries

Cranberries freeze well in dry-pack.

Gooseberries

Only two varieties (**Poorman, Chief**) have been tested here and both were satisfactory when packed in 25% syrup.

Grapes

Grapes must be harvested when fully ripe and washed thoroughly to remove spray materials, insect debris, etc. They may be frozen in small bunches or as single berries when covered with 25% syrup. All varieties tested have retained a flavour typical of the variety. Several varieties split badly when frozen. We recommend **Concord, Niagara, Cayuga, Lindley** and **Hungarian Vinifera**.

Peaches

Because a ripe peach is so soft in texture, delicate in flavour and becomes brown readily when in contact with air, it is one of the most difficult fruits to freeze satisfactorily. They may be quartered or sliced and covered with a 25%

syrup, or they may be sliced or pulped and mixed with sugar (4 to 6 parts of fruit to 1 of sugar by weight). The sugar pack is reasonably satisfactory with almost any well-flavoured peach. The best of the peaches for freezing in syrup are **Elberta**, **Vedette** and **Valiant**. A Vineland Seedling has been discovered which is thoroughly satisfactory but is not yet available in quantity.

A dip in boiling water may be used to remove the skin but the flavour is improved if the skin is left on the quartered pack. When the skin is left on, the peaches must be washed and rubbed sufficiently to remove the hairs and spray materials.

Plums

Most of the plum varieties grown in Ontario have been tested and on the whole they do not freeze with good quality. There is a tendency for the texture to be lost and the flavour is often extremely acid. The **Damson** plum freezes with fair texture when halved in 25% syrup and the flavour is characteristic. Other varieties which have given fair results in the same pack are **Pond's Seedling**, **Pringleau**, **Reine Claude** and **Grand Duke**. We recommend a very small pack of plums as a trial.

Raspberry

Cuthbert and **Viking** are the outstanding varieties for freezing in Ontario when they are used as a whole-berry pack. They are best covered with a 25% syrup but they give a reasonably satisfactory dry-pack. Almost any raspberry is satisfactory in flavour if it is slightly crushed and mixed with sugar (3 to 6 parts of berries to 1 of sugar by weight).

Rhubarb

Rhubarb is not strictly speaking a fruit, but it is usually used as such. All of the red varieties tested were satisfactory when the stalks were cut into inch lengths and packed in 25% syrup or when the pieces were slightly crushed and mixed with sugar. The proportion of sugar in the latter pack should be that which you prefer for sauces or pies.

Strawberries

Strawberries are probably the most popular frozen fruit but it is difficult to obtain even fair quality. All of the strawberries known lose their desirable texture when frozen whole and most of them develop unpalatable flavours in the whole pack. Slicing each berry into three or four pieces and packing in sugar (3 to 6 parts of berries to 1 of sugar by weight) is recommended. We do not recommend a whole pack for any berry likely to be available now. Select berries in the firm, ripe condition for the sliced pack.

A new seedling called **Vanrouge** is being multiplied as quickly as possible. It freezes reasonably well when packed whole in 25% syrup and is very high in quality when sliced in sugar.

VEGETABLES

All vegetables must be scalded (blanched). The purpose of the scalding is to develop and fix the colour and to stop certain chemical actions which during storage will cause undesirable flavours to develop. Scalding may be done in boiling water, steam, or in a pressure cooker, but ordinary household facilities are such that boiling water is the treatment recommended. The amount of scalding necessary varies with each different vegetable and it is recommended that the schedule given for each vegetable be followed closely. An ordinary alarm clock may be used to time the scalding periods.

Scalding or Blanching

We recommend that two large kettles of boiling water be used. The strongest source of heat available should be used under each kettle. About one pound of the raw vegetable is placed in a cheesecloth bag or wire screen and given a preliminary dip in the first kettle. This dip may last for 30 to 60 seconds. The vegetable is then transferred in its bag to the second kettle and timing is commenced when the second kettle returns to the boiling point. At the conclusion of the scalding period, the surplus water is allowed to drain briefly and then the vegetable is transferred to cold, clean water until it is thoroughly cooled. Moving the bag both in the scalding water and in the cooling water helps to bring about uniform heating and cooling.

Brine

A 2% brine solution may be used in the wet-pack of all vegetables. This is made by adding 2 parts of table salt to 98 parts of water by weight. This brine is left on the vegetable during cooking.

General Procedure for Vegetables

1. Harvest when at a stage of maturity which is most suitable for immediate use.
2. Wash carefully in cold water.
3. Trim or cut into appropriate sizes for packing and serving.
4. Scald (blanch).
5. Cool thoroughly in cold water.
6. Pack in containers.
7. Cover with cold brine (2%) or use dry-pack.
8. Freeze quickly at 0° F. or less.
9. Store at 0° F. or less.

Asparagus

Asparagus should be graded for size, trimmed so as to eliminate the white or purplish butts which are usually bitter. Cut to uniform length. It

needs thorough washing to remove sand. Sometimes the small leaflets must be removed, and if insect eggs are present it may be necessary to scrape the stalks with a knife. Scald sizes up to half-inch three minutes and larger sizes four minutes. Cool it thoroughly and pack preferably in 2% brine.

Asparagus loses its quality very quickly unless it is kept thoroughly chilled. The common variety **Mary Washington** provides an excellent pack.

Beets

Fresh young beets have been tested here one year only. We do not yet know the best method of treatment but the indications are that they should be completely cooked with the skins on before freezing and merely warmed with the skins on to prepare them for the table after freezing.

Broccoli

The common variety **Italian Green Sprouting** has given an excellent pack after scalding pieces suitable for the table for three minutes. The wet-pack was better than dry-pack. This vegetable is sometimes difficult to grow and the eggs and worms of the cabbage butterfly are difficult to remove by washing.

Brussel Sprouts

This popular vegetable freezes with good quality if the scalding period has been adequate. From four to five minutes scalding has been necessary for the average size heads. We prefer the wet-pack. **Long Island Improved** is the only variety tested here and it was satisfactory.

Carrot

Fresh, young, small carrots freeze with good quality when frozen whole, sliced or diced, particularly when packed in brine. It is possible that no scalding is necessary, though that has not been tested here. A one-minute scald has been better than longer scalding periods. **Tendersweet** and **Red-cored Chantenay** gave a good pack. These carrots were washed clean with a brush but the skin was not removed. If the carrots are young enough the skin is quite edible.

Cauliflower

The common **Snowball** variety packs well. The heads should be cut into pieces suitable for serving. They need careful washing and inspecting to remove insect eggs and worms. It should be scalded for four minutes, cooled and packed in brine. Dry-pack may discolour.

Corn-on-the-Cob

Properly frozen corn of a recommended variety makes an excellent frozen product either in wet- or dry-pack, though the wet-pack is preferred for long

storage periods. Special attention should be given to harvesting the corn at a stage of maturity which suits the taste of the individual. It deteriorates very quickly at ordinary room temperature and if there is any delay before processing keep the corn as cool as possible, preferably at 32° F. or in cracked ice. Remove the husks and silks, wash in cold water, trim the cobs to even lengths, scald all cobs of 1½ inches diameter or less for four minutes and larger ones for five minutes. Cool thoroughly in water, pack and freeze quickly. Varieties recommended are **Aristogold**, **Early Bancross**, **Golden Hummer**, **Harris' Extra Early Bantam**, **Kingcrost Bantam G7** and **Kingcrost Bantam Ear Pack B2**. The variety **Dorinny** has been highly recommended elsewhere.

Lima Beans

Lima beans can be grown with reasonable success in the Niagara Peninsula and when frozen before full ripeness is reached are an excellent product. The recommended scalding period is three minutes. The recommended varieties are **Carpinteria Green-seeded**, **Henderson's Bush Lima** and **Holmes' Green Prolific**.

Peas

Frozen peas are a popular product but only a few varieties are suitable for freezing. They are podded, washed, scalded for two minutes, cooled and packed either dry or in brine. Over-mature peas tend to taste like dried peas after freezing and if they are not mature enough there is too much wrinkling. The common variety **Thomas Laxton** is still the standard pea for freezing. **Roger's Icer** is good and **Telephone** is recommended for some districts but not in Western or Southern Ontario.

String Beans

On the whole neither yellow nor green string beans will give an entirely satisfactory frozen product. They are quite edible and have good appearance but the flavour tends to be weak. **Pencil Pod Black Wax** is a yellow bean which can be recommended and the following green beans may be expected to give a fair product: **Bountiful**, **Burpee's Stringless Green Pod**, **Full Measure** and **Kentucky Wonder**.

Beans should be picked before the seeds are well developed. Trim the ends. They may be frozen whole or sliced lengthwise or crosswise. They are preferable in a brine pack. Scald for three to four minutes.

Spinach

Most varieties of spinach freeze with good quality. There is some variation in bitterness from season to season. The variety recommended is **Giant Noble**.

It is necessary to harvest spinach before the blossom starts to form. Sand can be removed by kneading with the hands a small amount of leaves

in a large amount of clean water. The leaves are very bulky and can be packed into the cheesecloth bag and the bag pushed into the first kettle of boiling water with a spoon. In less than a minute the leaves are soft enough to occupy much less space and the bag can be twisted to eliminate most of the water before transferring the bag to the second kettle of water. The bag should then be loosened to allow its contents good contact with the boiling water. It should be scalded four minutes. The bag is twisted again to remove surplus water before it is transferred to the cooling water. After being cooled the mass of spinach is transferred to a kettle of brine and finally into containers, pouring off surplus brine as it is being packed.

Tomato

The tomato is really a fruit although it is used as a vegetable and it does not require scalding. No tomato is known which will retain sufficient texture to allow slicing after being frozen. Frozen quartered or pulped tomatoes retain their fresh flavour very well and no brine need be added.

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BULLETIN 413

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Ontario Department of Agriculture

Statistics and Publications Branch

TORONTO, ONTARIO

FOUR METHODS OF CHICK SEXING

BY

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4 Methods of Chick Sexing

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Sexing: by down color and pigmentation; by feathering; by sex-linkage; by color. Herein is given most useful information on a progressing subject.

INTRODUCTION

THERE is a growing interest in the sexing of chicks at hatching time. Various methods of sexing have been practised with a fair degree of accuracy. Two of the most important methods used are the colour sexing of Barred Plymouth Rocks and the feather sexing of several of the other pure breeds. The more general application of sexing will no doubt come into practice as sex characteristics are studied and applied in breeding practices.

Sexing of chicks is best carried on when the chicks are not over forty-eight hours old. It is true there are certain sex factors that do not show up until the chicks are about ten days of age but these are perhaps of secondary importance although they are sometimes checked to confirm earlier observations.

The sex characteristics to be observed may vary with the breed but the following are the major points to be considered:

1. Colour — as appearing in the chick down and the pigmentation of the shanks and toes;
2. Feather—the length and relationship of the primary wing feathers and, at a later age, the main tail and wing feathers;
3. Sex-linkage—an inheritance behaviour of certain characters common to some breeds;

4. Colour — where using the dominant white factor.

1. SEXING BARRED PLYMOUTH ROCK CHICKS ON DOWN COLOUR AND PIGMENTATION

In sexing Barred Plymouth Rock chicks by this method, the head is the most reliable characteristic. The face and shank colour are considered secondary factors. Chicks produced from matings where dark exhibition males have been used, are usually more difficult to sex than those from production stock, which is usually lighter in colour.

One should not attempt to sex the chicks until the down is dry. In order to show the down colour on the face, the birds must not be fed as the fine meal in the down would obscure the true colour.

2. FEATHER SEXING

There is a sex variation in feather development in certain sections of the plumage in most breeds, if not all. The factor is more definite in some breeds than in others, largely due to more selective work having been done in the establishment of this character.

In day-old feather sexing the major wing feathers are the ones considered. The main feather spread of the wing is made up of two sets. The outer group, extending from the wing tip to the first main joint, is termed the primaries, while

(Continued on page 5)

I. Sexing Barred Plymouth Rock Chicks

In Fig. 1 is shown pure bred Barred Plymouth Rock chicks not over twenty-four hours old. The top group A, are pullets and lower B, are cockerels. One may easily observe the following characteristics as related to the sexes:

Sex	Head Spots	Face	Shanks and Toes
Pullets A	A distinct white area, regular in outline, in the form of a stripe on the back of the head.	Distinct black around the beak and eyes.	Dark colour, usually changing abruptly at the base of the foot; sometimes the colour continues on the upper side of the toes.
Cockerels B	The white colour is scattered, intermingled with the black and irregular in outline.	Dark brownish-grey down around the beak and eyes.	Varying shades of colour, usually even throughout and lighter than the pullets.

Fig. 1



II. Feathering Sexing

Pullets C (top)
—Rows of primary wing feathers long; the under row is definitely longer than the upper.

Fig. II

Cockerels D (bottom) —The rows of primary wing feathers short, usually equal in length; some may have upper row longer than the lower.

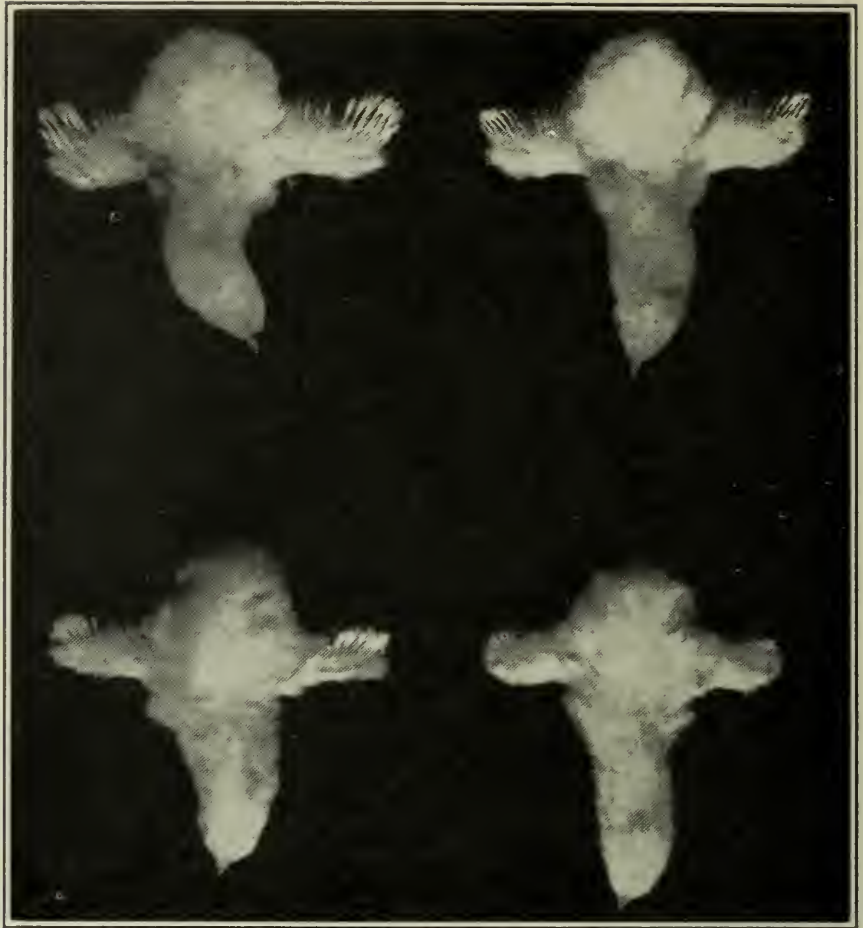


Fig. III

Enlargement of wing types in Fig. II: (right)—pullet C; (left)—Cockerel D.

the inner set nearer the body is known as the secondaries; or the primary fan and the secondary fan. While the primary and secondary sets are usually considered as single rows of feathers, actually in the primary set there are two rows, one underneath the other. At day old one studies the outer or primary fan only and in it compares the length of rows of tiny feather shafts within that fan.

At ten to fourteen days of age there is a distinct difference in length of main tail feathers, as shown in Fig. IV. At this age one can also distinguish and compare the length of the secondary wing feathers with the primary wing feathers,

that is, the length of the outer fan with the inner fan. In the cockerels the inner fan or secondaries is shorter than the outer fan or primaries. In the pullet the inner fan or secondaries is practically as long as the outer fan or primaries, giving the appearance of one complete fan.

These feather sexing factors apply to matings of pure-breds or hybrids, using long feathered males and short feathered females. This long and short feathered characteristic is being developed in several of the more popular pure breeds at the present time. Fig. II shows pure bred White Leghorn chicks hatched from a mating such as the above. If the re-

Feather Characteristics of 10-14 Day Old Chicks

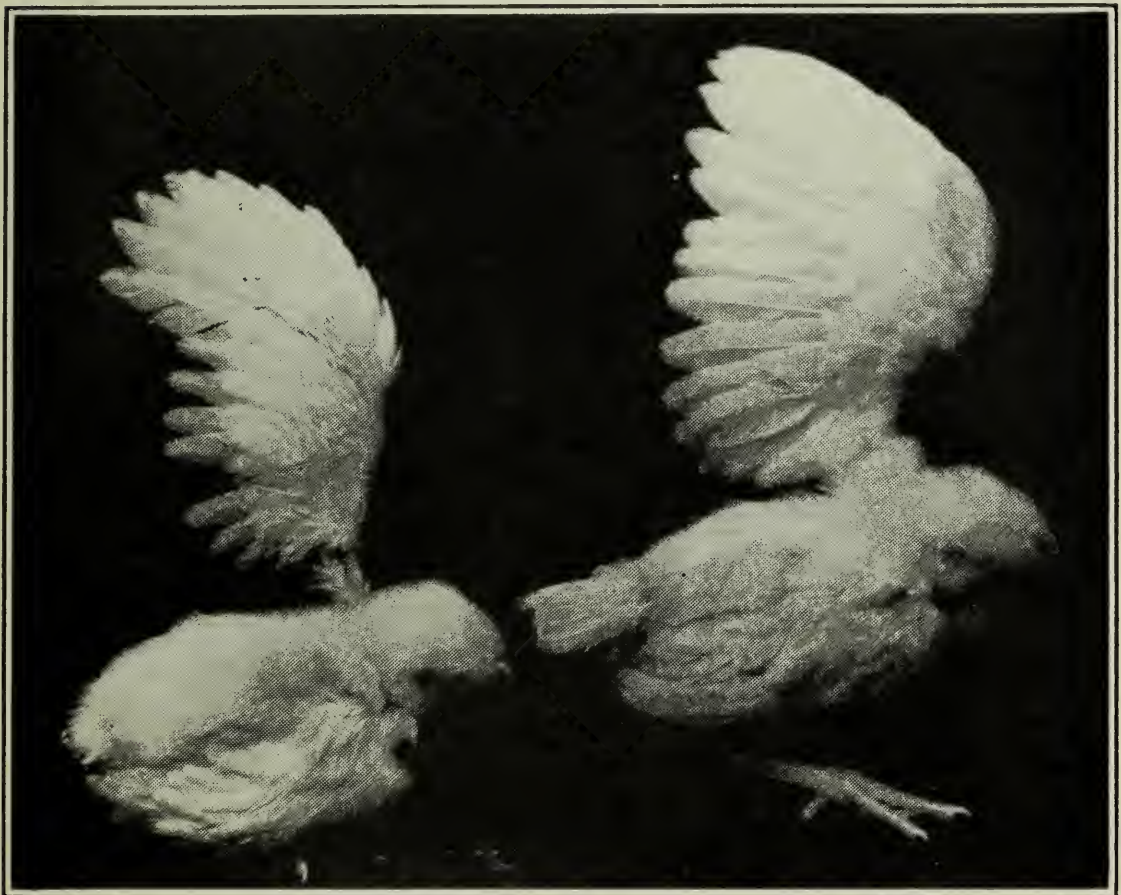


Fig. IV

Cockerel D (left) : No tail feathers; secondary wing feathers are much shorter than the primaries.

Pullet C (right) : Distinct tail feathers, secondary wing feathers practically as long as the primaries, making a complete fan.

verse cross is made, using a short feathered male and long feathered females, the resulting offspring will show, in both male and female, short primary wing feathers as in the cockerels, Fig. II.

In order to satisfactorily carry on with the foregoing method of sexing, it is necessary, as suggested above, to mate long-feathered males to short-feathered females in order to produce the required characteristics in the chicks.

3. (a) SEXING BY MEANS OF SEX-LINKAGE, USING THE BARRED PLYMOUTH ROCK FEMALE

In this case again special matings must be made to produce chicks to which the sex factors will apply. Barred females are mated to a male or males of one of the following colours: black, black-red, most buffs and recessive whites (White Wyandottes). Chicks from such crosses will present the following characteristics shown in Fig. V (E and F).

III. (a) Sexing by Sex-linkage, Using a Barred Female



Fig. V

	Chick Colour	Adult Colour
Pullet E	Head is entirely black, no white spots.	Almost entirely black, may have ticking on head, neck and breast; dark shanks.
Cockerel F	White markings on head, similar to Barred Rock male.	Barred in appearance.

Mating barred males to unbarred females, gives female G and male H.

Dominant white, such as found in the Leghorn and Plymouth Rock, cannot be used to produce the same result as the White Wyandotte.

Using the reverse cross, mating barred males to unbarred females, gives female G and male H chicks barred, as illustrated in Fig. V.

Due to variation in colour this latter cross cannot be colour sexed in the manner outlined for pure Barred Plymouth Rocks, as illustrated and described under that section of this Bulletin.

3. (b) Sexing by Sex-linkage, Using Silver Females

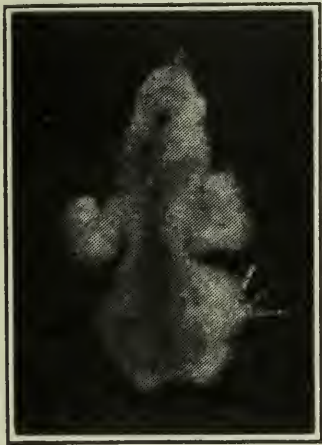
The term "Silver" as used here applies to such varieties as Light Sussex, Light and Dark Brahmans, Silver Pencilled and Columbian varieties, and some White

Wyandotte strains. Females of any or all of these when mated to a male or males of the following varieties, *i.e.*, red, black red, most buffs, partridge and golden laced colours, will produce chicks with the characteristics shown in Fig. VI.

4. SEXING BY COLOUR, USING THE DOMINANT WHITE FACTOR

In Fig. VII is shown chicks from a cross of a Barred Plymouth Rock male mated to White Leghorn females. The accuracy of this method is, however, not too reliable. Similar results may be obtained in any mating where a dominant white is present in either parent. The White Leghorn and White Plymouth Rock are usually considered to carry this
(Continued on page 8)

III. (b) Sexing by Sex-linkage, Using Silver Females



*Pullet
J
(left)*



*Cockerel
K
(right)*

Fig. VI

Sex	Chick Colour	Adult Colour
Pullet J	Buff or reddish down; sometimes showing striping.	Buff or reddish colour; may show some stippling or striping.
Cockerel K	White or cream down, sometimes smoky; may show striping.	White colour with black in hackle, wings and tail.

If the reverse crosses are made to those suggested above the chicks, both male and female, will all be silver in appearance as in cockerel K. The chicks from such crosses cannot be colour sexed.

factor. If the reverse cross had been made, for example using a long-feathered White Leghorn male and short-feathered

Barred Rock females, the chicks could then be sexed by the feather method, as shown in Fig. II.

4. SEXING BY COLOUR, USING THE DOMINANT WHITE FACTOR



Pullet
L
(left)

Cockerel
M
(right)

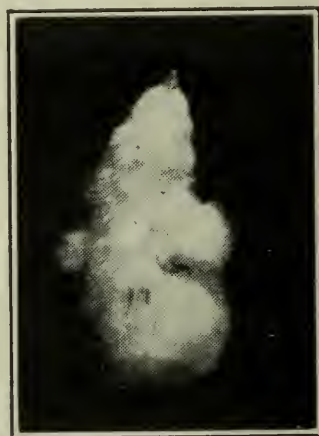


Fig. VII

In Fig. VII is shown chicks from a cross of a Barred Plymouth Rock male mated to White Leghorn females. The characteristics shown are as follows:

Sex	Chick Colour	Adult Colour
Pullet L	White with several black spots scattered throughout the down.	White with several black spots throughout the body plumage.
Cockerel M	White with a few black spots scattered throughout down.	White with a few black spots on body.

VENT SEXING

No attempt is made here to describe or discuss the sexing of day old chicks by the vent method. This method of sexing is much more difficult to learn than the others which have been described. Vent sexing requires considerable practice to attain any degree of accuracy. A strong light, keen eyesight and careful

handling are some of the factors necessary for sexing chicks by this method. Carelessness or rough handling may cause injury to the chicks which may be more or less permanent. The opportunity of practising on large numbers of chicks is necessary to acquire any degree of efficiency and speed.

Photographs in this bulletin were taken by
W. D. Tolton, Department of Extension, O.A.C.

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TORONTO, ONTARIO

CAPONS AND HOW TO CAPONIZE

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Figure No. 1—A typical six-months-old capon.

Capons and How to Caponize

by
EARLE SNYDER, M.Sc.

Introduction

THE ART of caponizing has been practised for many centuries but never very extensively except in certain relatively small localities. This practice is one in which cockerels are unsexed or castrated by the removal of the sex gonads or testes just as is done with male calves, pigs and lambs to produce steers, barrows and wethers. The purpose is also the same, that is, to retain as a result of this operation, for a longer time than is the case in the uncastrated animal, the tender and delightful eating qualities of the young animal.

Age

The necessary operation may be per-

formed at any age from ten days to seven or eight weeks. The average poultryman will, we believe, as the result of experiments, find five weeks a suitable age because the gonads at this time are large enough to be easily seen and removed intact. The birds also recover quickly from any shock incurred and continue to grow with only slight interruption. This is, in our experience, less true with older and larger birds. Only an expert can successfully operate at an age younger than three weeks. Our experience indicates definitely less hemorrhage with birds five weeks old or younger than with older birds. Moreover the loss of a small bird does not represent as much feed or other



Figure No. 2. Vigorous two week old Barred Plymouth Rock Cockerel, suitable for caponizing.



Figure No. 3. A healthy six week old Barred Plymouth Rock Cockerel.

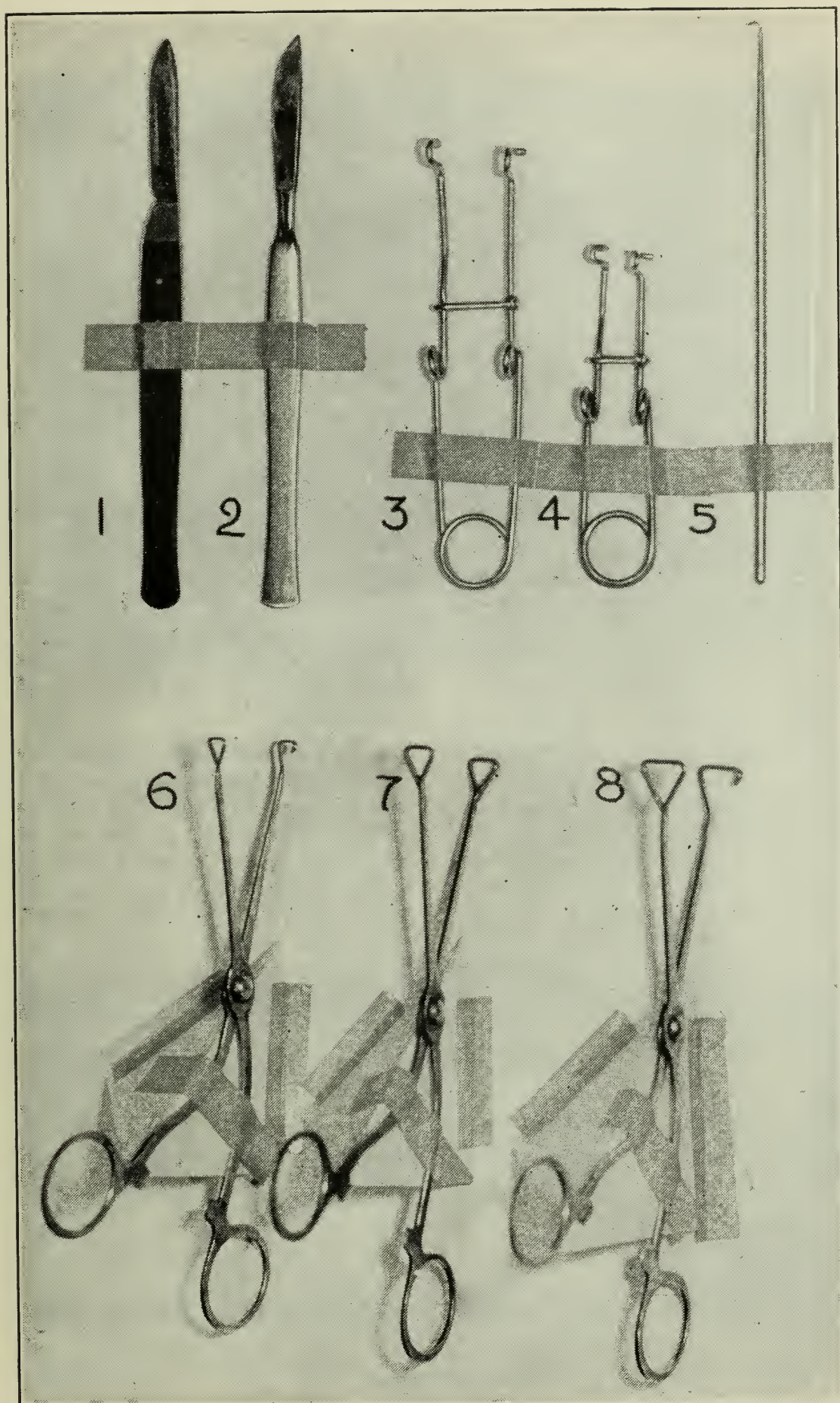


Figure No. 4. Caponizing tools graded in size for use with cockerels of different ages.

expense as does the loss of an older bird, even though it may be used for food, as such birds have little or no market value.

Most Suitable Breeds

The cockerels of any breed may be caponized—any of the dual purpose and heavy breeds are used for this purpose. First generation crosses are very suitable and sometimes flesh up and finish even better than standard bred birds. S.C. White Leghorns and other varieties of the lighter breeds may be profitably caponized but should not be held much beyond eighteen weeks of age. After this they take too many pounds of feed to produce a pound of gain to be profitable. Barred Plymouth Rocks make excellent capons due to their relatively rapid growth, fine textured meat and high quality. These features are emphasized in strains specially selected and bred for meat type.

Mortality

There need be very little loss from mortality resulting from the operation. If the operator has any aptitude at all for such work sufficient skill can soon be acquired so that losses greater than from one to five per cent. are unnecessary. Two to three per cent. is a normal loss for a careful operator. To avoid serious loss only growthy, vigorous birds should be

used for this purpose. Weak, unthrifty chicks are very unsatisfactory and should never be caponized. This is particularly true of birds showing any signs of bronchitis or any other respiratory infection. Mortality following recovery from the operation is usually no greater than is the mortality suffered by cockerels. The fact that a bird has been caponized does not make it more difficult to rear.

Speed

The average operator may, with practice, acquire sufficient skill to caponize from twenty to thirty birds per hour. Much depends on the temperament of the operator and the equipment available. Some can successfully operate on from forty to eighty or more birds per hour, but the ability to do more than fifty birds per hour is a comparatively rare accomplishment. When speed is important an assistant is employed to fasten down and remove the birds from the operating table.

Equipment and Technique

Special instruments are necessary for this work and may be secured from any poultry equipment sales house or directly from the manufacturers. Sets of such instruments usually consist of a scalpel, a combination hook and probe, a spreader

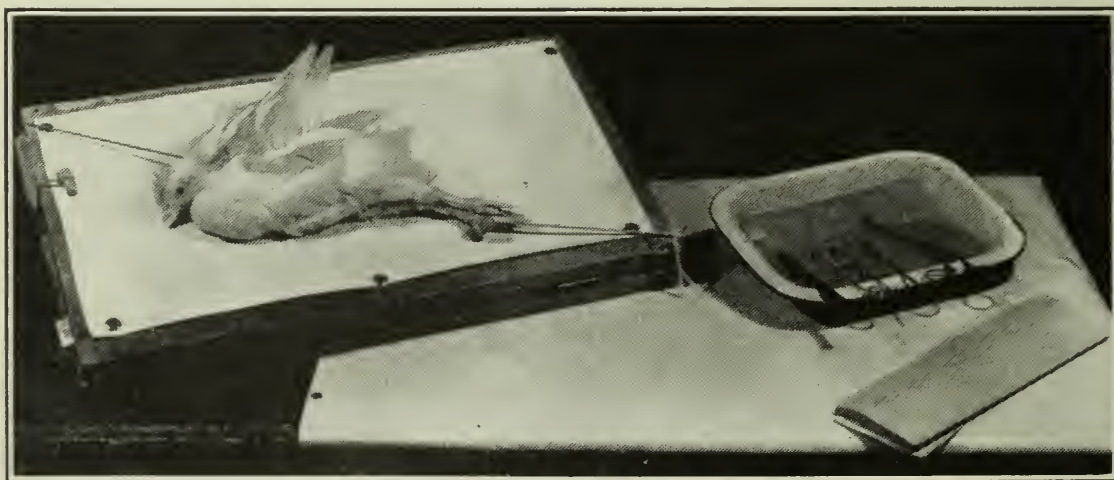


Figure No. 5. Homemade operating table with bird and equipment and showing point of incision.

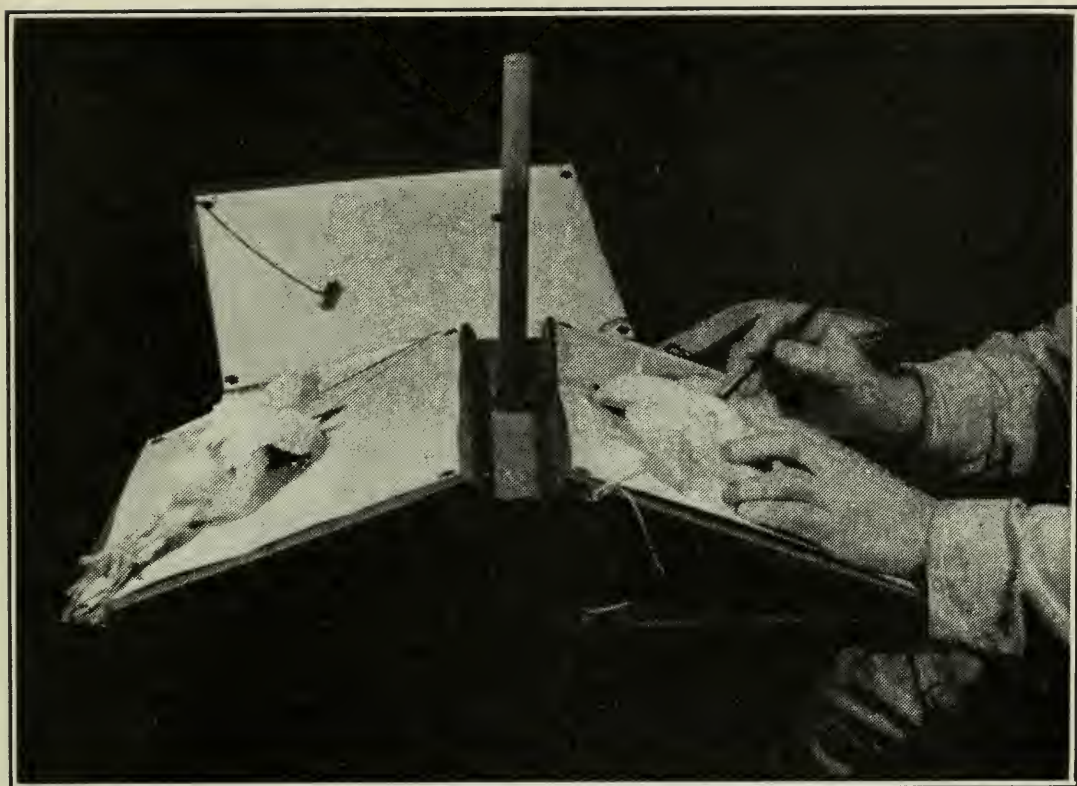


Figure No. 6. Revolving caponizing table with several birds in position, extra board and operator in position for work.

and forceps or remover. There are many styles of instruments but they fall into two general types, electrical and non-electrical. The electrical sets use an electrical knife and remover. These tend to cauterize the incision and the point where the testicles are detached, and it is claimed their use results in fewer slips and prevents hemorrhage. Several small electrical cells, or one cell of an ordinary six volt battery, may be used as a source of current, or a small transformer for use in a connection from an electric light socket may be purchased with the instruments. We have used both types of equipment successfully and find no very great difference. Because of their lower initial cost and greater handiness, non-electrical instruments still remain much the more popular. Greater speed is also possible as one is not forced to wait for the remover to become sufficiently heated for use.

It is important that the spreader and forceps be light in weight and of such shape as to obstruct vision as little as possible. Curved handles on such an instrument also facilitate good vision. In figure 4 is illustrated three sizes of such forceps, number 6, 7 and 8. These are adapted for use with 2-3 week, 4-5 week and 6-8 week old birds respectively. The locking device is shown just on the inside of the finger loops on the handles. Several sizes of spreaders, two styles of scalpels, and a combination hook and probe are also shown. The small spreader, No. 4, is used with ten day to three week old chicks, while No. 3 serves for 6 to 8 week old birds. An intermediate size may also be purchased.

In figure 5 is shown a simple home-made operating table which we have found satisfactory. It consists of two boards anywhere from about 12" x 16" to 12" x 20" in size, hinged on the longer

sides. A piece of broom handle or other piece of wood serves to elevate the operating surface to various angles. The bird is held down as shown. A cord with a small block or a hook on one end is fastened at a convenient length to a staple at the lower right hand side of the table. A similar cord slips through a staple at the upper left hand corner and may be adjusted to any length under the bevelled piece of wood fastened just below on the board's edge. A small block attached to the loose end of the cord prevents it from slipping through the staple. The bird is fastened by its legs and wings by forming a noose by use of the small hooks. This makes a simple, easily adjusted tie or shackle and one moreover that can be quickly applied and released. The table itself may be set on a barrel or some other suitable surface at a convenient height. We like a table large enough, as illustrated, so a shallow

dissecting dish lined with a folded paper towel may be placed convenient to the operator. In this dish the tools are placed in operating order. The towel prevents dulling of the scalpel edge. A weak solution of some suitable disinfectant serves to keep the tools clean and it is also available to wet down any feathers or down at the point of incision and to brush over the wound after the operation has been completed. There is little danger of wound infection if such simple precaution is taken with instruments and wound.

Where time and speed are factors, a small revolving table on a tripod at such a height as will allow the operator to sit on a box is convenient. The table includes three removable boards fitted with shackles as above described and which are placed on the revolving top two at one time. The third is used to fasten a spare bird while the operator completes

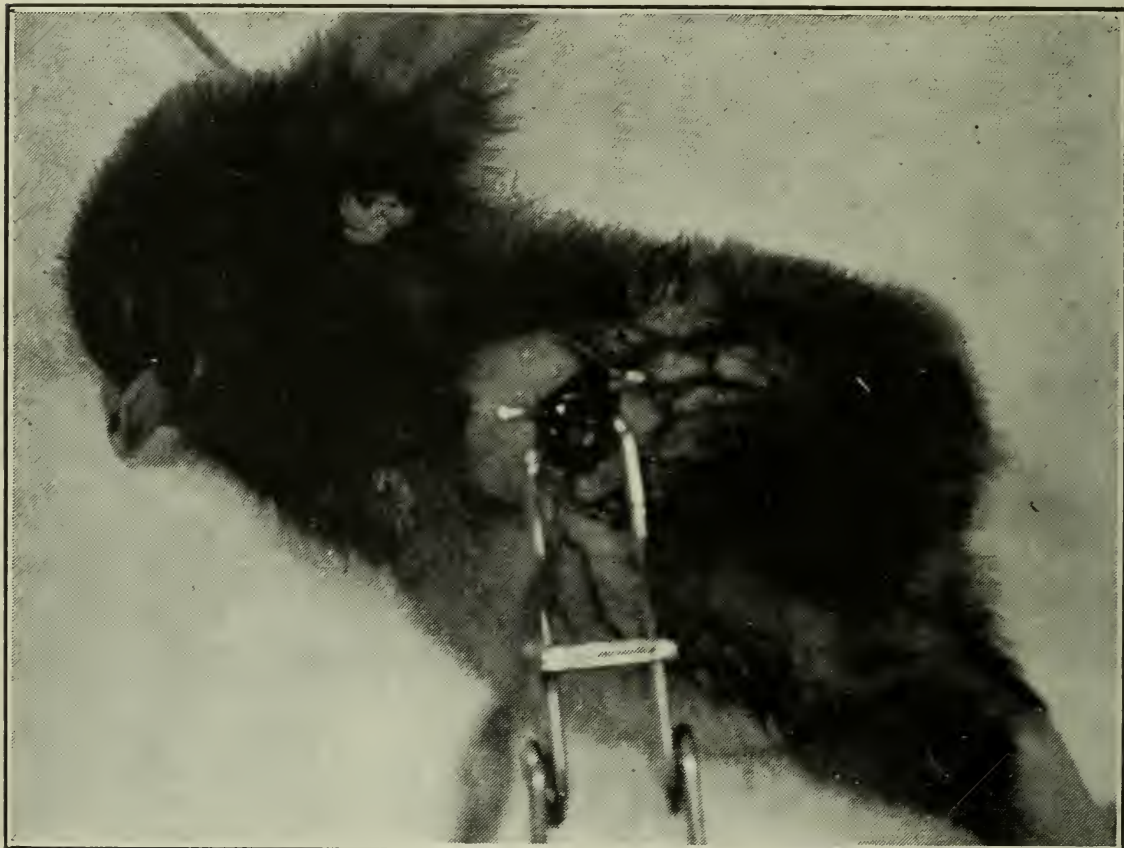


Figure No. 7. Ten day old chicks can be successfully operated on.

work on one of the two birds before him. When completed, he revolves the table, and the board holding the finished bird is removed by an assistant who then places the third bird in its place. Thus the operator has a continuous supply of birds available. The instruments are placed on a small stand within easy reach and at a convenient height for speed and comfort. The operator's seat is so constructed as to hold his coveralls and equipment when not in use, and also may hold a series of small batteries which supply current for a head lamp clamped to the operator's forehead. This lamp may be of homemade construction and will serve to direct a beam of light directly on the operative area (Figure 6). In addition to instruments and a table, several poultry crates or batteries conveniently placed are necessary, the one to hold the supply of cockerels and the other to receive the capons.

Adequate Light

Adequate light is essential for success in operating; otherwise difficulty will be experienced not only in locating and clearly seeing the gonad for removal but also in making sure no part of the organ

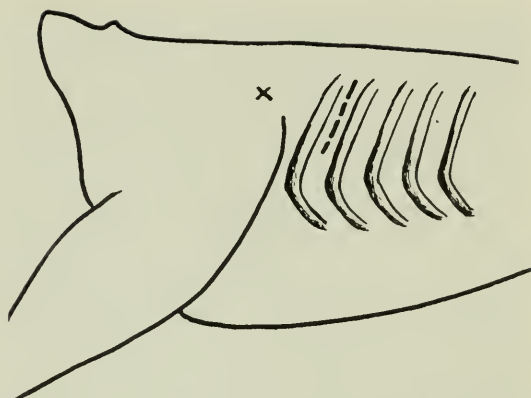


Figure No. 8. The dotted line shows the location of the incision between the last two ribs, the X the position of the hip.

has been left in the bird. A bright sunny day is best and the operator should set up his equipment where the sunlight will shine over his shoulder into the body cavity. This may be, depending on the time of day, directly inside a south or west window or it may be outdoors. Artificial light is difficult to arrange satisfactorily as the heat from a lamp placed over the shoulders of the operator so as to direct the light properly, may be too great for comfort. A head lamp made from a focusing flashlight fastened by a band to the operator's forehead and

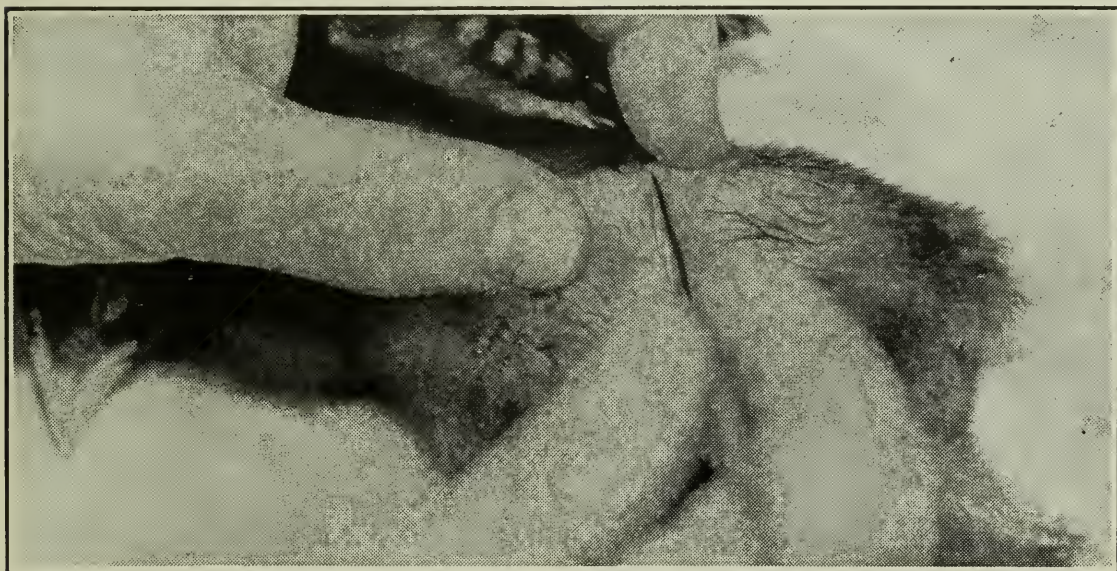


Figure No. 9. Skin drawn to one side and tightly held between thumb and forefinger and showing point of incision.

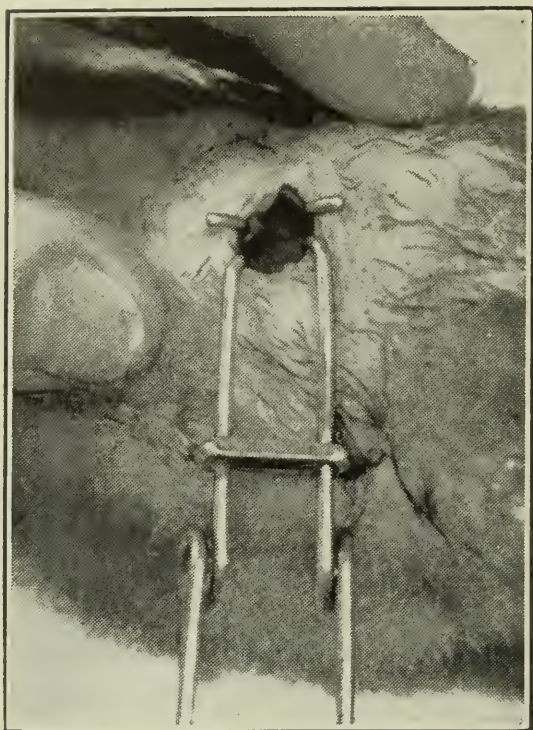


Figure No. 10. Two week old Barred Plymouth Rock cockerel opened and with spreaders inserted.

attached to batteries as already suggested, will give excellent illumination where most needed. This aids greatly in pre-

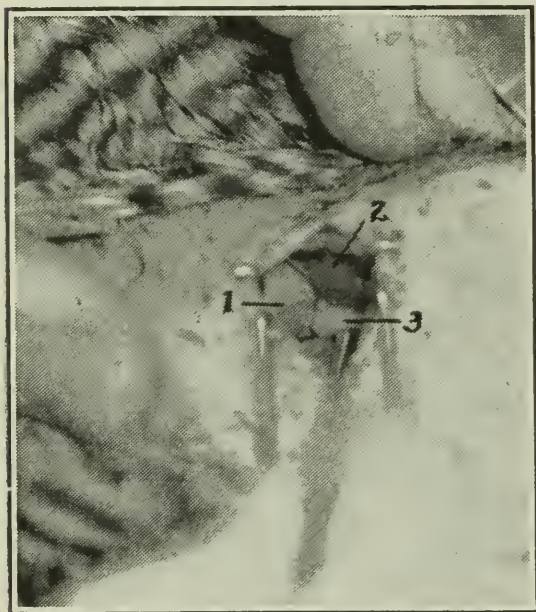


Figure No. 11. Six week old bird, showing position of left testicle where lung and kidney meet. (1) Lung, (2) kidney, (3) testis.

venting slips. Good light is particularly important when operating on young birds. Beginners are well advised to work only in good light.

Care and Management

Prior to being caponized, the cockerels should be starved for a period of from twelve to eighteen hours, though some water may be given. This serves to empty and collapse the intestines, which allows better vision for the performance of the operation. Longer starving tends to weaken the birds and may result in a greater than normal setback. Following the operation, the birds should be given water to drink and they may be fed mash either immediately or within a short time. Feeding may then be carried on as usual. They should be held in a battery brooder of suitable size, or placed in a warm, clean colony house for a period of at least a week or two before moving them to the range. Care must be taken that the capons are not chilled following the operation, or heavy losses will probably result.

The Operation

The starved bird is stretched on the operating table on its right side, as shown in figure 7, and fastened securely, being careful to stretch tightly but not too much so. Having the bird in the correct position on the table assists greatly in properly aligning the internal organs for greatest ease in operating. A few quick pulls will remove any down, pin feathers or feathers from an area over the posterior ribs and just in front of the hip bone. Young chicks need little plucking, which saves time. The plucked area and surrounding feather growth are now moistened by means of the fingers or a small sponge dipped in a weak disinfectant solution. With the fingers of the left hand the intercostal space between the last and second last rib is located (figure 8), the skin is drawn forward from the hip and tightly stretched between the left

thumb and forefinger (figure 9). With the razor edged scalpel held between the thumb and forefinger, the skin is laid open in one stroke, then the knife is reversed and the point is pricked through the muscle between the ribs at the lower end of the skin incision and is run upwards to a point just in front of the hip. The incision will be from $\frac{3}{8}$ to $\frac{3}{4}$ of an inch long, depending on the age and size of the chick. The spreader is then carefully inserted (figure 10). If the incision is properly made, the upper edge will have exposed and slightly opened the upper edge of the air sac wall. This air sac is situated just inside the opening. With knife or hook tear through this thin tissue far enough to expose the testicle; it may also be necessary to lengthen the incision in some cases. With practice one can open the bird and air sac without use of either probe or hook and so save time. By opening the skin first, the thigh muscle is exposed, so can be moved aside with the knife point, while the intercostal space is opened. This facilitates quick healing. Drawing the skin forward tends to avoid severing the long radicle of the large cutaneous vein which crosses the body diagonally from the thigh to the wing. Severing this vein, while not serious, often causes sufficient hemorrhage to confuse the beginner by obstructing his vision; a bit of absorbent cotton will remove any blood. With practice the incision can easily be made with no hemorrhage and little pain.

If the incision has been properly made and the intestines are collapsed from starving, the left testicle will be in plain view just below the front end of the kidney (figure 11). It will vary with the bird in size, shape and color, but is more or less bean shaped and usually yellowish grey in color. Sometimes the testes are partly or completely black in color and more difficult to see. Such organs are not diseased and will develop normally

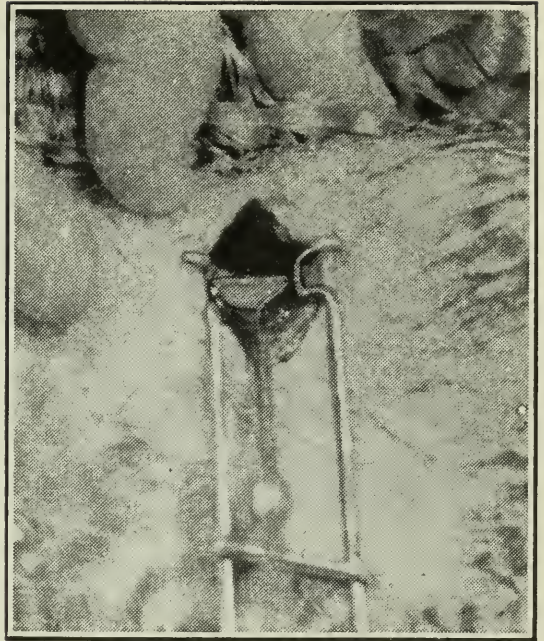


Figure No. 12. Testicle in jaws of remover.

and become functional in mature males. The operator will soon learn to accurately

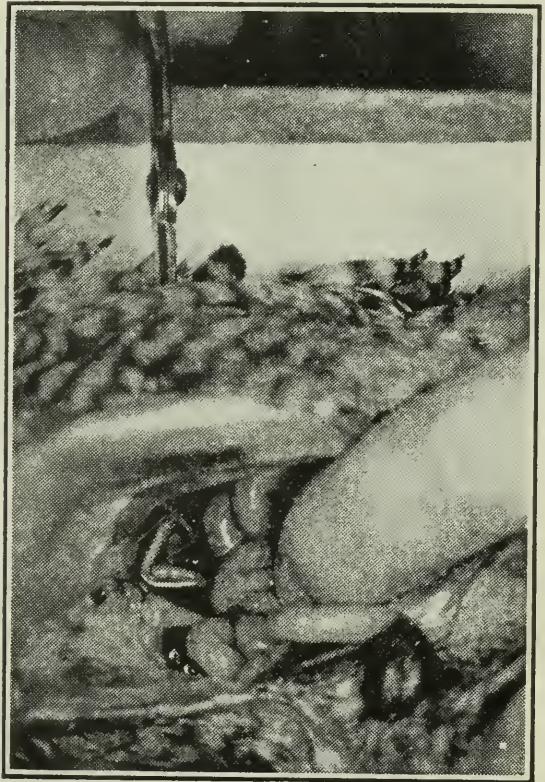


Figure No. 13. Bird opened to show method of grasping testicle with remover.

distinguish the organ, regardless of shape or color.

Almost directly below the upper or left testicle will be the lower or right organ separated from it by a thin membrane; raising the upper organ will expose the lower one to view. Some operators rupture the membrane and remove the lower and then the upper organ from the one incision. It is, however, more difficult to accomplish and the beginner will find it easier to make incisions on both sides and remove one testis through each incision. Some of the speediest and most experienced and successful operators do the work in this way, especially with ten day to three week old cockerels. It is difficult to grasp the lower organ with the forceps unless a special hook with a small knob at the end is used to raise the organ sufficiently so the forceps may be manipulated around it for removal. If the upper organ is removed first, any slight hemorrhage will obscure one's vision so the

lower one cannot be seen.

The forceps or remover is now inserted through the incision held open by the spreaders, and the testis is secured between its jaws (figure 12). This is done by raising the organ slightly with the instrument closed, then allowing it to fall back and while so doing quickly opening the forceps and grasping the organ by manipulating the lower jaw under it before closing it again. With the locking type of forceps, care is necessary to draw the testis well away with the jaws slightly open, before locking the remover. This taking up of the slack is advisable in any case. Otherwise the large vein lying along the back and between the two testes may also be caught in the remover and be ruptured, resulting in the death of the bird. The forceps with enclosed testis is now gently withdrawn through the incision with a twisting motion until the various tissues connecting the organ to the body are severed (figure 14). The



Figure No. 14. The testicle withdrawn through the incision but still attached to peritoneal tissue.

spreader is now removed, allowing the skin which had been pulled to one side to spring back and cover the opening and so prevent foreign material from entering (figure 15). The bird is now turned over without unfastening and the remaining testis removed in a similar way.

Caution

Care is necessary to make the incisions between the last and second last ribs (figure 16). If made one space forward the lung is likely to be injured and, if behind the last rib, there is no rib to resist the spreader, making it necessary to hold the spreader in place with one hand while manipulating the forceps with the other. There is also danger of kidney injury and it is more difficult to locate the testis.

It is very important that not only every particle of both testicles be removed but also the capsule or sac of peritoneal membrane surrounding each testis, including its attachments, the epididymus and a short piece of the vas deferens or cord. If this is not done, a high percentage of slips will usually result. To facilitate clean removal of all parts, the jaws of the remover must make perfect contact from corner to corner so that all tissue enclosed between them is removed. Locking the instrument helps the beginner to do this. With practice and experience, however, the successful operator develops a sense of touch which enables him to exert just the right amount of pressure to remove all parts without necessitating the slight delay of each time locking and unlocking the jaws of the forceps.

The principle danger in caponizing is in accidentally rupturing one or more of the large blood vessels found in close proximity to the sex organs. The rupturing of certain of these results in such severe and immediate hemorrhage that death results in a few minutes. The rupture of certain smaller blood vessels may also result in profuse hemorrhage but



Figure No. 15. Two week old bird with operation completed. Skin has sprung

from such injury practically all vigorous birds will quickly recover. If good light is available and care is taken to avoid including such blood vessels with the testis between the jaws of the forceps when removing it, there will be little danger from the operation. The beginner will find a demonstration by an experienced caponizer of great help. If this is not possible, confidence regarding technique may be developed by operating first on a dead bird.

Wind Puffs

Following the operation and for about the following three weeks some trouble will probably be experienced with wind puffs. This often follows the unavoidable puncture of the abdominal air sacs during the course of the operation. This results in the air escaping from the air sacs through the incision between the ribs where it becomes trapped between the skin and the body wall. The skin incision is soon closed by a scab and then heals over quickly, more quickly than the incision between the ribs. The bird rapidly becomes bloated and unless relieved becomes uncomfortable, awkward in getting about, may lose appetite and finally die. Puncturing the skin of such

a bird with a sharp pointed knife will correct the condition quickly and may need to be repeatedly done with some birds for a period of from seven to twenty-one days. Care need only be given to the more severely bloated birds. Usually anywhere from fifty to ninety per cent. of the capons will show some wind puff or bloating, but only a comparatively small percentage will need to be opened. Chilling of capons should be particularly avoided until wind puffs have quite disappeared.

Slips

'Slips' are birds on which the operation was not successful. Any portion of either testicle left intact and not removed will

regenerate sufficiently to result in the development of a red comb and wattles. The bird will crow, fight and in general act like a cockerel. The larger the amount of testicular tissue that is missed, the more and sooner the masculine traits will develop. Some with little testicular tissue remaining, may not develop combs until well matured. Conspicuous slips are best removed from the capons as they may become a nuisance; they are intermediate in their ability to fatten, in grade and in value, between capons and cockerels. From three to twenty-five per cent. slips is common, this varies with operators and to a degree with breeds. Figure 18 shows the regenerated testicular tissue com-

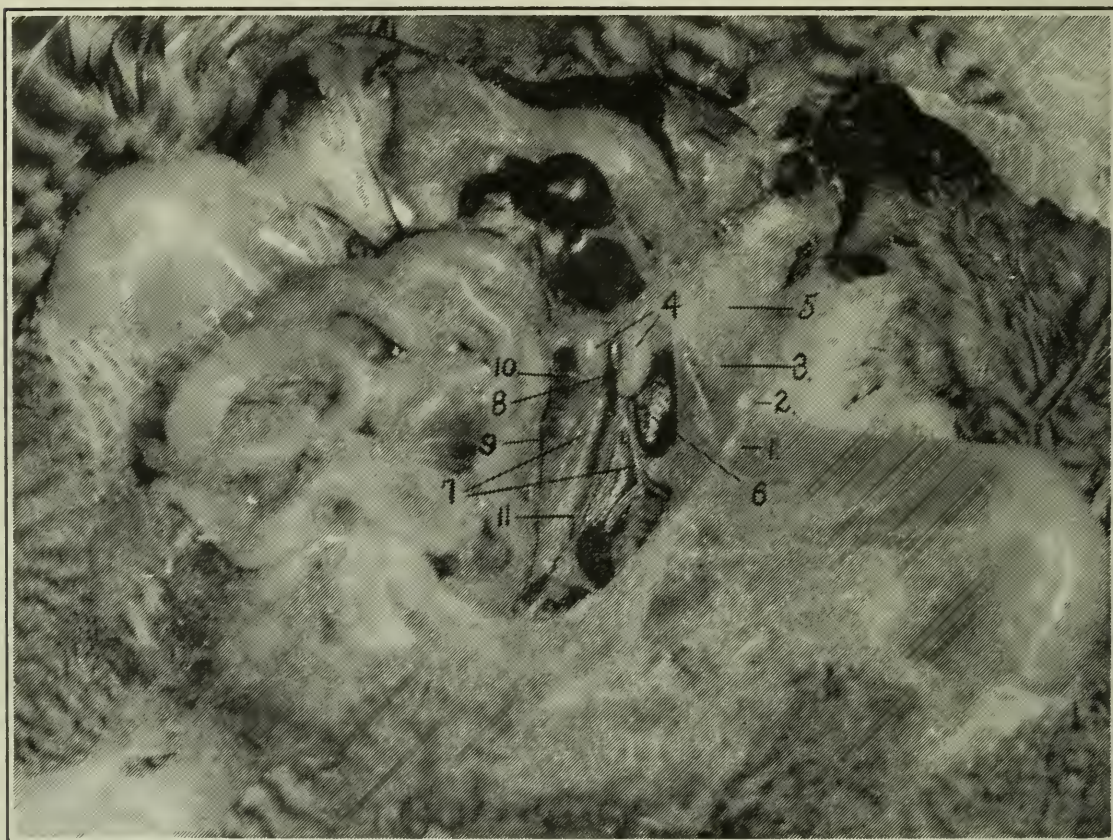


Figure No. 16. Position of gonads in relation to blood vessels and ribs. Last and second last ribs, (1) and (2), between which incision is made. Walls of abdominal air sac (3) must be ruptured to reach testes (4), which lie at the rear end of the lungs (5) and front end of kidneys (6). The right and left iliacs (7) unite to form the posterior Vena cava (8). The coccidial vein (9) and the Messenteric artery lying in close proximity to it, are sometimes ruptured when operating. A thin peritoneal membrane (10) separates the testes, the left one of which lies slightly posterior to the right one. A spermatic artery leads to each testis from the anterior dorsal aorta (11).

pared with the size of comb and wattles in eight month old birds. If one-quarter to one-half of one organ remains the bird may never show capon traits.

Feeding and Management

Capons need no special care after the wounds have healed. They will do well on a good growing mash and grain, fed in the usual way, and will fatten satisfactorily on grain upon nearing maturity. It is wise to grow such birds by themselves on a good range where green feed and shelter are available. They may be ranged with pullets but should not be reared with cockerels. Any ration suitable for rearing roasters will be satisfactory for capons.

Housing

No special housing is necessary. Colony houses or range shelters are excellent for

housing capons during the rearing period. They need heat following the operation and until bloating is overcome but otherwise heat requirements are no greater than for cockerels or pullets. In the fall capons may be placed in any suitable poultry house until pen fattened or until placed in the fattening crates.

Capons tend to be more quiet and docile than are cockerels and tend to spend considerable time on the roost; this is particularly true as they near maturity. The type of perches used is then of importance as there is increasing evidence that roosts are at least a factor in the development of crooked breasts and breast blisters. In marketing turkeys it has come to our attention that round perches of such size that the birds can grasp firmly produce much fewer unsightly breast injuries than is the case

TABLE 1
(Feeding time three weeks)

No. Birds Fed		Grade Lowered Because of Blisters	% Birds of Lowered Grade
Crate fattened	449	98	21.82
Pen "	904	8	.09
Totals	1,353	106	7.83

TABLE 2

Pounds of feed to produce one pound of gain with cockerels and capons during a three week fattening period prior to dressing at 12 weeks, 18 weeks and 32 weeks of age.

12 Weeks			†18 Weeks		‡32 Weeks	
No. Birds	Lbs. Feed per Lb. Gain		No. Birds	Lbs. Feed per Lb. Gain	No. Birds	Lbs. Feed per Lb. Gain
<i>White Leghorns</i>						
Cockerels 79	6.74		86	4.34	45	32.00
Capons 83	7.07		86	4.14	17	11.56
<i>Barred Rocks</i>						
Cockerels 81	5.39		84	3.59	69	5.96
Capons 79	5.09		84	3.95	61	5.25
<i>New Hampshires</i>						
Cockerels 79	4.75		112	6.03	34	6.42
Capons 86	5.94		108	5.45	80	6.66

where two inch by four inch perches with rounded edges are used. Observation indicates that the bird sits on the round roost with its legs close together and with its breast, in consequence, raised above the perch and cradled between the thighs. There is therefore little or no rubbing injury on the breast resulting from movement or swaying of the bird's body while perching. On the larger and wider perches the bird cannot secure so firm a grip so sits with its legs wider apart and with the breast in greater contact with the perch surface. There is therefore more rubbing and it would appear, more injury. It is suggested that round, easily grasped perches may be a factor in preventing breast injuries in capons as well as turkeys. We have also observed more breast injuries, especially blisters, on birds housed in range shelters having wire

floors than where such floors were not used.

Fattening Capons

Capons may be fattened in crates, in pens or on range. Range fattening is reasonably successful only when the birds near maturity. Following a rather elaborate capon trial in 1937, employing some eight hundred capons about equally divided between three breeds, along with a like number of cockerels, we suggest that for the average farmer, pen feeding is probably the most satisfactory method of fattening capons and perhaps also cockerels. In order to produce birds grading Milkfed A under Canadian grading standards, a three week fattening period is usually necessary. While capons, according to our experience eat well and take on somewhat more finish in crates than in pens, there are many more breast

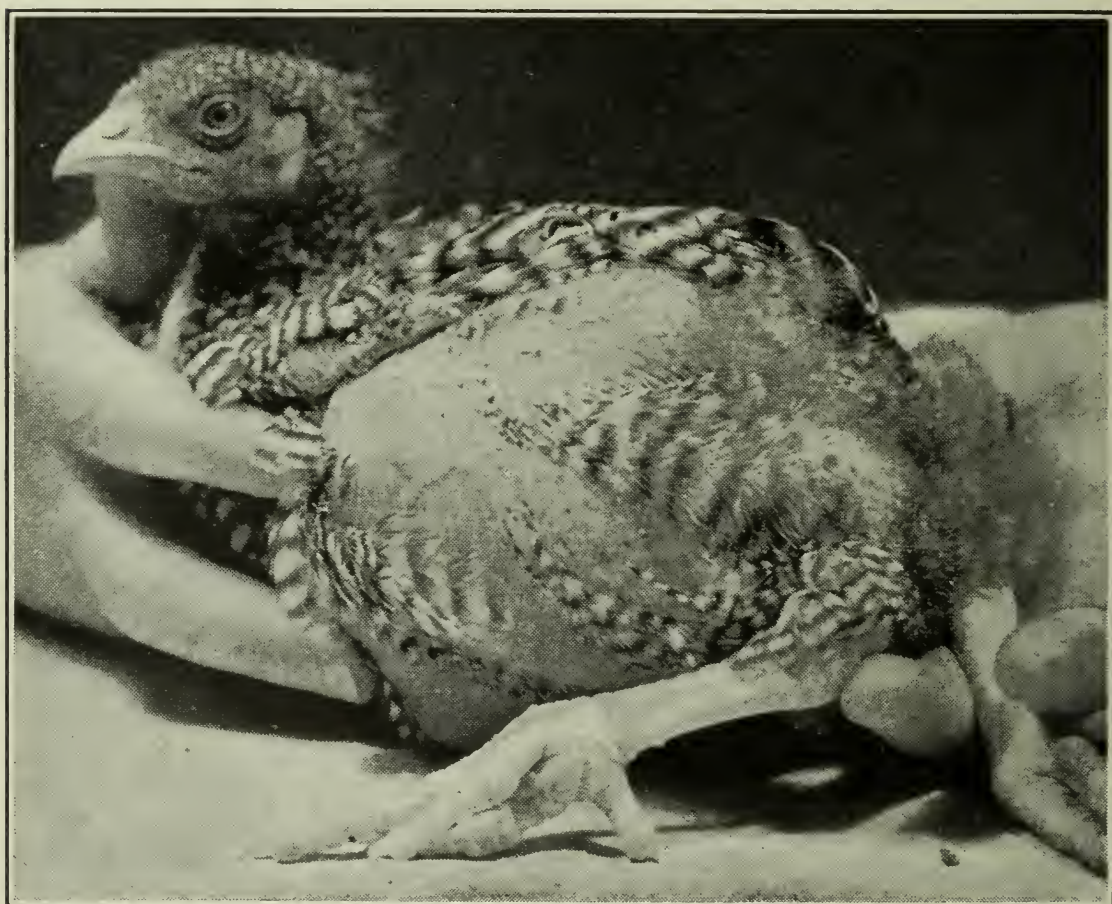


Figure No. 17. Windpuff.

blisters developed by birds in crates than is the case with those fattened in well bedded pens. As a result, the pen fattened birds when sold on rail grade, actually produced greater net returns than did the somewhat more highly finished crate fed birds because the latter had a greater percentage of breast blisters and graded lower in consequence. In Table No. 1 consideration is given to both cockerels and controls dressed at the ages of twelve weeks, eighteen weeks and thirty-two weeks.

Considered by breeds, White Leghorns had 6.6% lowered in grade because of blisters; Barred Plymouth Rocks 6.5% and New Hampshires 10.02%. The capons showed a definitely higher percentage of blisters than did the cockerel controls, possibly because they spent more time resting on the wire crate floor than did the more active controls.

There was no significant difference in the percentage of birds lowered in grade because of crooked breasts; the crate fattened birds having 5.57%, those pen fattened 5.08%; and with an average for all of 5.17%.

In more recent work, we have in several tests succeeded in lowering the percentage of blisters developed by birds fed for three weeks in standard welded wire fattening batteries, as much as two thirds. This was done by placing $\frac{7}{8}$ inch perches, $2\frac{1}{2}$ inches wide and with well rounded edges, down the centre of the crate floors. These perches served to raise the birds' breasts above the wire while roosting on them between feeds, and so prevented much of the "normal" breast injury found on the birds in the control pens where perches were not supplied.

The amount of feed to produce a pound of gain varied little either between crate fed and pen fed birds or between capons and controls. This is shown in table No. 2.

These data include both pen and crate fattened birds.

†Gains made by those birds finished and dressed at 18 weeks of age were particularly good.

‡It would appear that the White Leghorn cockerels and also the capons had passed the point where economic gains were possible.

(Work reported by Robertson and Munro¹ also supports this conclusion.)

Effects of Caponizing

Disposition and appearance: The presence of the sex gonads tends to inhibit fat deposition and, to a slight degree, size. There is also some control over feather shape and length but the development of the comb, wattles and ear lobes is stimulated. Capons do not develop male head gear; their heads remain relatively small and pale and they have an effeminate appearance. The body shape is also somewhat feminine. They are longer feathered; seldom, if ever, crow, and are quiet and docile. They are not inclined to fight, do not disturb pullets and are much easier to handle than cockerels.

Herein lies what is probably one of the several more important reasons for caponizing. Where cockerels are kept for from 20 to 26 weeks of age or older, as is necessary for the production of roasters, considerable loss from fighting is often experienced. A number of reports of such losses have been received from farmers and we have also had some similar experiences.

Capons are not subject to such loss and this lowered mortality will in itself often more than compensate for the expense of caponizing. Jeffrey³ reports comparative losses with White Leghorn cockerels and capons as 18% and 9% respectively at 20 weeks of age and 20% and 9% at 32 weeks. Greater loss of cockerels generally becomes quite noticeable after 10 weeks of age and is experi-

enced with the heavier as well as the lighter breeds of chickens.

Rate of Growth: While many people are of a contrary opinion, rather extensive experiments at both Wisconsin University² and the Ontario Agricultural College, Guelph, clearly indicate that at no period up to 28 to 32 weeks of age do capons grow more rapidly nor do they attain a significantly greater size or weight than do control cockerels. These experiments included four standard bred varieties and three crosses. Until about 18 weeks of age capons are actually smaller than cockerels. While capons continue to grow over a somewhat longer period than control cockerels, and while they retain their quality for some time after cockerels of the same age have become staggy and tough, the cost per pound gain after they have attained an age of about 26 weeks is excessive. Unless a very special premium-paying market is available the birds should be marketed at about 26 weeks of age.

Where a late market is supplied, we believe it better under Ontario conditions to hatch at such time as will produce capons of not over 26-32 weeks of age at the time of sale. Successive hatches with the birds being marketed at 26 weeks will likely produce greater satisfaction than will be the case where capons are held to an age of eight to ten months. A 5-7 lb. roaster is more easily marketed than larger and older birds.

Feed Costs: The cost of feed is only slightly lower per pound of gain with capons than with cockerels. ¹Dominion

Experimental Farm experiments show an advantage of .5% to 8% in lower feed costs for capons when marketed at 26 weeks of age. Wisconsin and O.A.C. experiments show no significant advantage up to 28 and 32 weeks, respectively, while South Dakota⁵ reports a slightly greater cost for capons than for cockerels.

Fattening Ability: Capons show considerably greater fattening ability than do cockerels. This becomes evident at about 16 weeks of age and is marked at 26 weeks. Fat is readily accumulated over all sections of the body and between the muscle fibres. Capons fatten readily in pens or may be finished for a few weeks in crates. As already stated, crates should have well rounded roosts placed down the middle of the floor to allow the birds to roost while resting. This keeps their breasts from contacting the wire, thus greatly assisting in preventing blisters or breast boils.

Quality: Due to the more docile nature of capons there is less tendency to develop connective tissue and this, coupled with their tendency to fatten readily at any age after 16 weeks, results in excellent quality of meat. Capons also retain this quality for some time after cockerels have become tough, coarse and staggy. The meat of capons is delicious because of its fine, tender quality and because it is juicy and mild. With increased age, however, capons also become stringy so that it is usually not advisable to hold such birds beyond 8 to 10 months.

TABLE 3

	12 Weeks	18 Weeks	32 Weeks
	%	%	%
S.C.W.L. cockerels	78.48	45.4	8.88
“ capons	48.19	82.5	88.23
B.P.R. cockerels	93.82	64.3	49.27
“ capons	78.49	79.9	85.25
N. Hamp. cockerels	68.35	25.8	22.22
“ capons	55.81	61.0	66.67

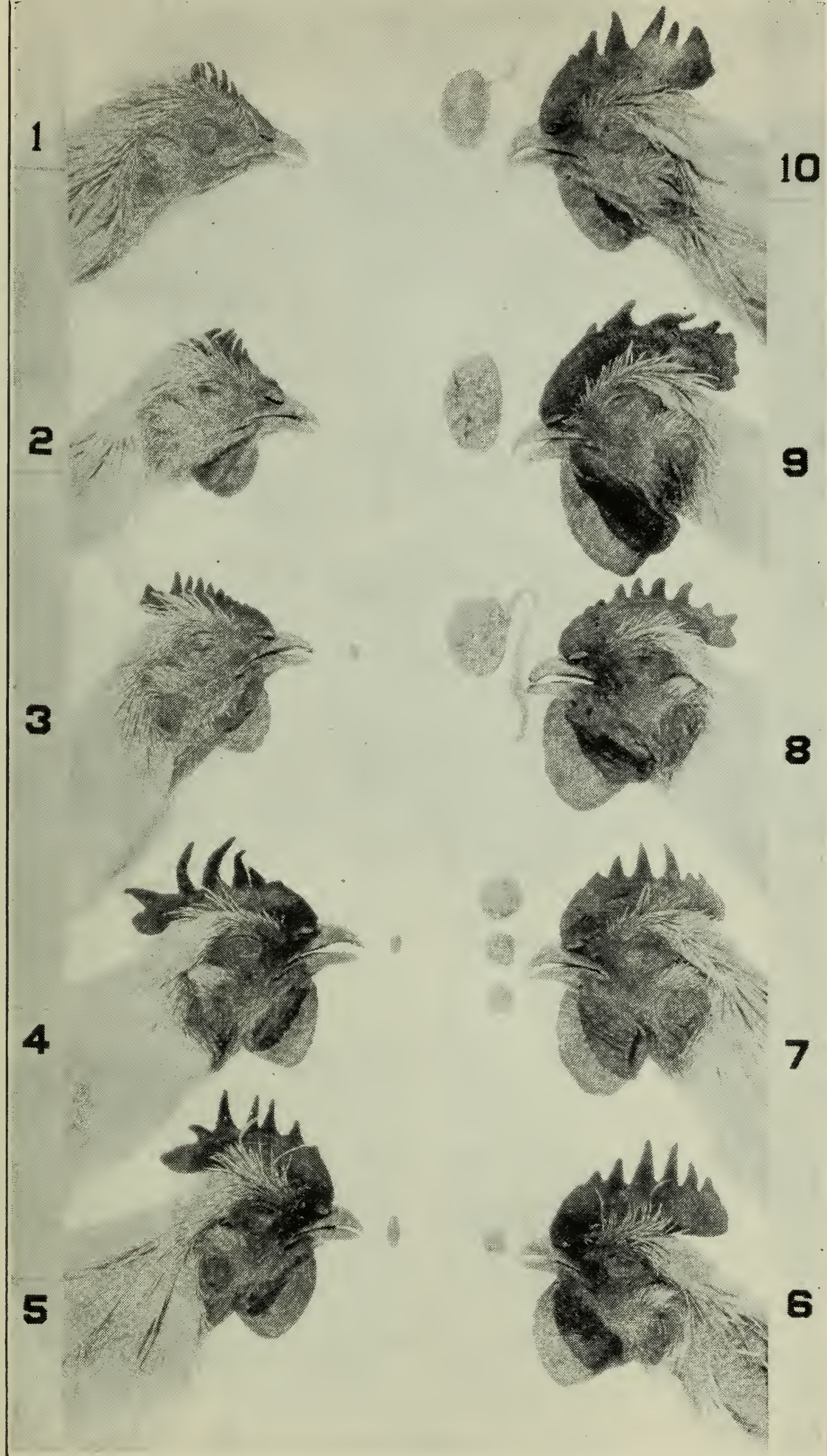


Figure No. 18. The head of a capon (1) and progressive stages of slips (2 to 9). Number (10) is that of a cock showing one gonad. The size of the regenerated testicles taken from the bodies of slips is shown in front of each beak. As the size of the regenerated organ increased, the size of the comb and wattles also increased. At eight months of age No. 2 would have been accepted as a capon, while Nos. 7, 8 and 9 never showed capon characteristics.—Courtesy Kansas State Agricultural Station.

COMPARATIVE GROWTH of COCKERELS & CAPONS

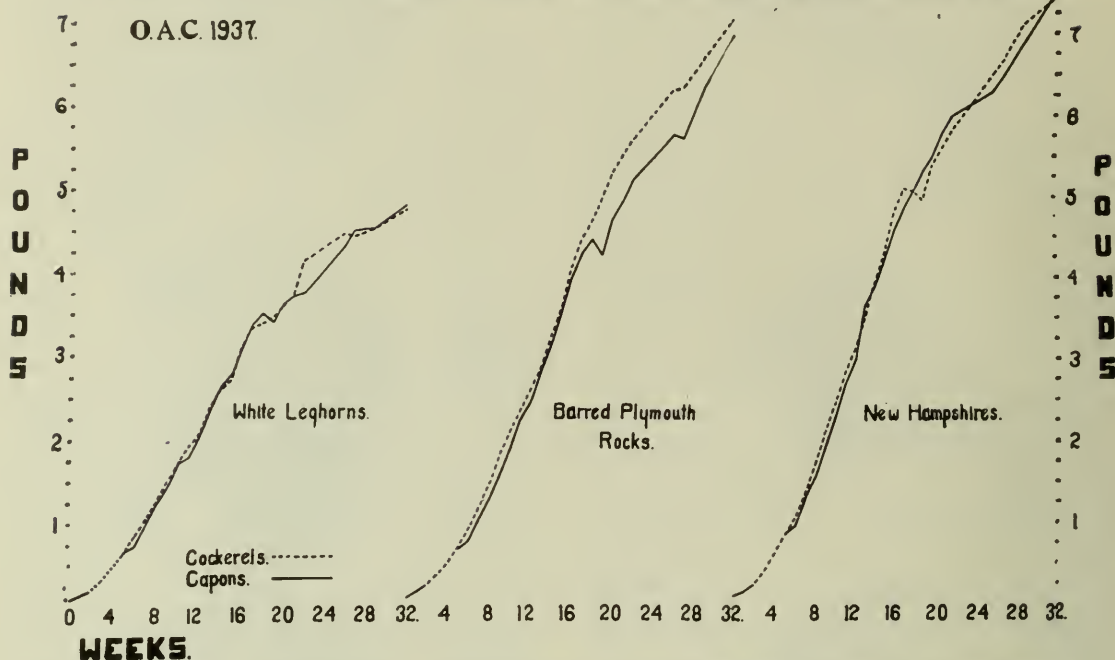


Figure No. 19. Comparative growth curve of cockerels and capons of three breeds.

Grading and Returns: Capons grade well if properly fed for finish. In comparing the grades of fairly large numbers of such birds of three different breeds with control cockerels, we have found the capons much superior. This superiority was sufficiently marked to secure for them almost a three cent premium per pound over the cockerels as a considerably higher percentage of capons than cockerels were graded in the top grades. In addition to this advantage, capons sometimes command a premium because of their widespread reputation for quality. This premium varies from one to three cents per pound, being one cent in this case. While the merit of such premiums over cockerels of similar grade is perhaps questionable, the fact most certainly remains that the superior grading of capons earns them a relatively higher price per pound than can be secured for cockerels. This amounted to 3.7 cents per pound or 20.3 cents per bird for the 32 week old capons. Wisconsin² reports the income above feed costs for capons as being 64c as compared with 34c

for control cockerels, the capons selling at 22c per pound while the cockerels commanded only 18c per pound.

W. E. Poley of the South Dakota Experiment Station⁵ in a recent report covering three and four years' work respectively with cockerels and capons, states that in spite of rather unfavorable conditions for poultry production during two of the test years, capons averaged a net return of twenty-five cents per bird while control cockerels averaged a net loss of six cents per bird. Other somewhat similar reports from Ontario points indicate that one can reasonably expect anywhere from ten to thirty cents premium for capons over cockerels and that under special conditions this premium may even be at times exceeded.

Table No. 3 shows the percentage of top grades of capons and cockerels at various ages.

The top grades include specials, Milk-fed A and B, and Selected A. The above table shows clearly the advantage of holding capons until at least 18 weeks of age. From this time on the capons finished

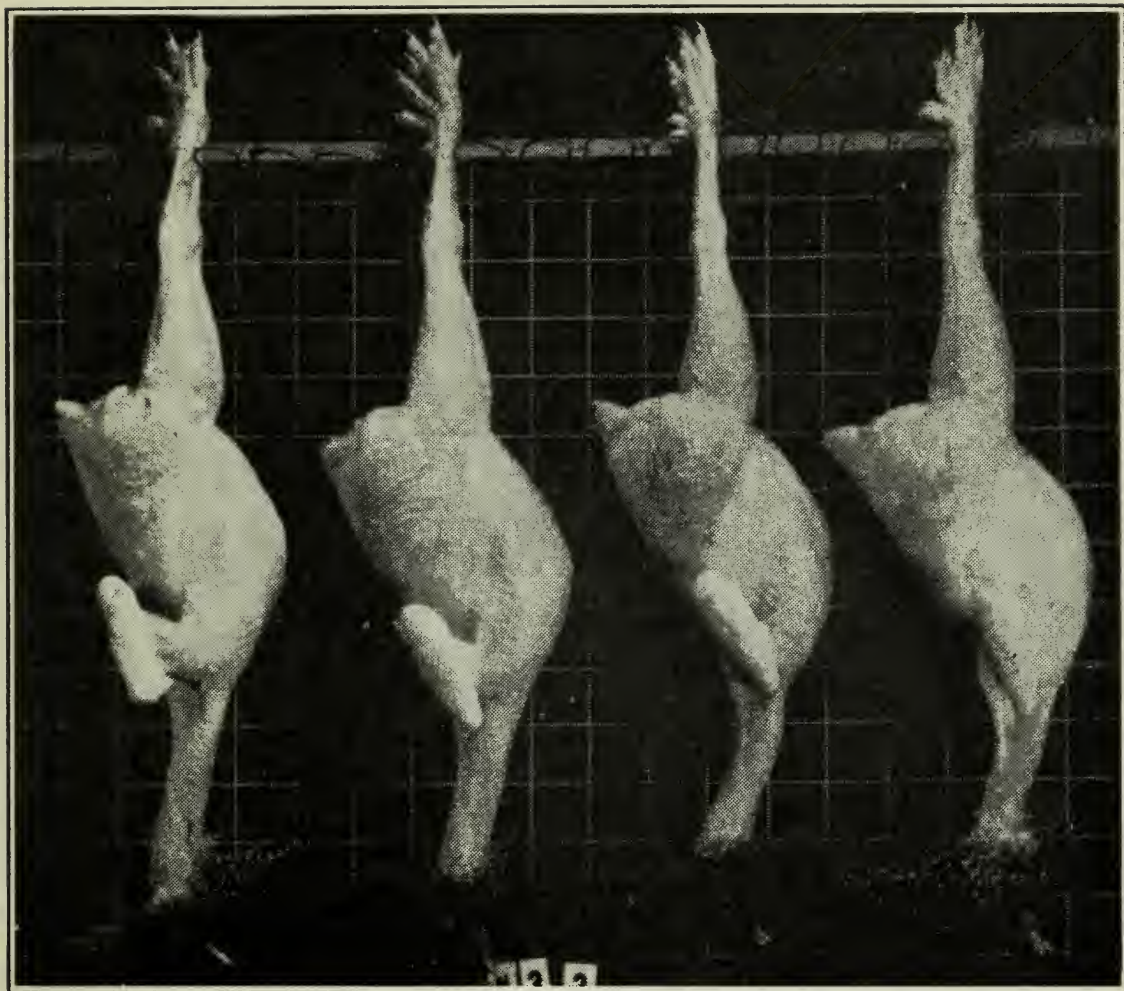


Figure No. 20. Four Barred Rock dressed capons (side view).—Courtesy W. A. Maw, Macdonald College, P.Q.

and graded much better than did the control cockerels.

Who Should Caponize

Anyone desiring to produce the highest quality roasting chickens, either for market or for home consumption, may learn to caponize. Sufficient skill must of course be acquired and enough birds should be caponized each year to make it practical and economical to purchase the necessary instruments. Those farmers and poultrymen who prefer to do so, may purchase capon chicks. A rather extensive business has been developed by several expert caponizers in Ontario. These men secure baby cockerels from hatcheries and, after caponizing them,

brood them for a short time prior to selling them out to customers at three to four weeks of age as capon chicks. Such work is facilitated by widespread chick sexing which makes available for this purpose large numbers of both standard bred and first generation crossbred baby cockerels. These and other experienced caponizers may also be engaged, at so much per bird, to caponize the farmer's own cockerels, or sexed cockerels may be purchased by anyone to be custom caponized at any desired age by such local skilled caponizers.

Does It Pay to Caponize?

Unless performed by the poultryman himself caponizing involves an added

expense of from three to five cents per bird and the capons need special care until they have quite recovered from the operation. They are not profitable as broilers but must be reared to at least small roaster size. However, where access is had to a market that will pay a premium for quality, or where market poultry is rail graded or sold on grade, the production of capons may prove a profitable undertaking for the farmer. The fact that capons are quiet and more easily handled and that they do not suffer the same mortality from fighting as do cockerels reared to roaster age, may also be of sufficient importance to induce the production of such birds. There is no doubt that high quality poultry is inducive to greater consumption. The production of a large number of capons may be an important means of securing that result.

There is the possibility then, that a more widespread adoption of the practice of caponizing for the production of roasting chickens, would enable farmers and poultrymen generally to more profitably market their cockerels than is now the case. There is also the possibility that some of the baby cockerels now being gassed at the hatcheries, especially those of the heavy breeds, could be profitably

saved and reared. This practice could then become another important factor in the production and consumption of high grade poultry meat in Canada, to the profit of the producer and the enjoyment of the consumer.

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Ontario Department of Agriculture

Statistics and Publications Branch

TORONTO, ONTARIO

Results of Four Years' Demonstration Work with Potatoes on Fifty-Seven Different Farms in Ontario

The work herein reported was carried on jointly
by

Dominion Experimental Farms Service
Ontario Agricultural College
Agricultural Representatives
and
Potato Growers of
Middlesex, South Simcoe, York
and Ontario Counties

Results of Four Years' Demonstration Work With Potatoes on Fifty-Seven Different Farms in Ontario

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and

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Ontario grows approximately 30 percent of the total acreage of potatoes produced in the Dominion of Canada. Although the province as a whole is not particularly suited for potato growing, the potato is found on more farms than any other single crop. On many farms the acreage is small, and does not warrant the expenditure in machinery and equipment necessary for the proper handling of the crop. In other instances the potato crop is considered as a side line by growers, and does not receive the attention necessary to obtain profitable yields.

During 1936 an extensive potato experiment was begun in the Caradoc area in Middlesex County by the Central Experimental Farms Service, Dominion Department of Agriculture, in co-operation with the Ontario Agricultural College. This investigation into such problems as low yields, off type, pear shaped potatoes, and difficulties encountered in producing potatoes of high quality was requested by the Caradoc Potato Growers' Association. The experiments were conducted for four years on three areas representing different soil types in Middlesex County. In 1938, at the request of the potato growers of South Simcoe County, similar experiments were begun in the Alliston area of that county. A number of investigations of the same nature were undertaken in York and Ontario Counties in 1940.

In addition to the main experiments, a series of acre plots have been planted on fifty-seven separate farms in the potato growing areas of Middlesex, South Simcoe, York and Ontario Counties to demonstrate the value of good seed, judicious fertilization, effective spraying, and good, practical, cultural methods. Each demonstration plot was located in a representative area of the grower's field, and grown adjacent to a check plot.

The results obtained on the experimental areas and put into practice on the demonstration plots are presented at this time as five factors that contribute to success in potato production.

1. Certified seed of a suitable variety.
2. A plentiful supply of plant food supplied through crop rotation, the use of barnyard manure, artificial fertilizers, and green manure crops.
3. Early planting.
4. Efficient spraying.
5. Proper methods in harvesting, grading, packaging, and labelling.

1. Certified Seed of a Suitable Variety.

Good seed of a suitable variety is one of the most important factors in securing a profitable crop of potatoes. Although all other conditions might be ideal for a bumper crop, lack of the proper seed may result in a failure. The only guarantee that growers have that potatoes are fit for seed purposes is to use fully certified stock. Certification does not mean that seed potatoes are entirely free from all diseases, but it is an assurance that the minimum of disease is present.

The first problem that confronts growers in the production of a crop of potatoes is that of the variety to grow. While the potato has a fairly wide adaptation as to environment, yet it is similar to our other crops in that certain varieties are much more suited to certain regions than are others. The choice of a variety must, therefore, be governed by its adaptability to its environment and to the purpose for which it is grown, the early or late market, the commercial market or for seed purposes. The Dooley was the main variety of potatoes grown on farms in the Province of Ontario for a number of years. This variety has shown a high degree of resistance to mild mosaic and some resistance to scab, but is quite susceptible to Fusarium Wilt and Yellow Dwarf. It is a late maturing variety, being about fifteen days later than Katahdin and twenty-one days later than Chippewa (two varieties which have recently been introduced into the province). The Dooley keeps well in common storage, but its table quality is only fair, as, when cooked, it is inclined to be dark and slightly bitter in flavour. Since the commencement of the potato investigational work in 1936 a number of varieties have been under test in several of the main potato growing areas of the Province. The results of this work would suggest that further testing is necessary before any definite recommendations can be made as to which is the most suitable variety or varieties for the different potato growing areas and for the main crop in Ontario.

2. A plentiful supply of plant food supplied through crop rotations, the use of barnyard manure, artificial fertilizers, and green manure crops.

The potato crop has a comparatively short growing season, and is a heavy feeder. If profitable results are to be obtained it is necessary that the required nutrients be in the soil in an available condition when needed by the crop. These nutrients are best supplied through crop rotations, the use of barnyard manure, artificial fertilizers, and green manure crops such

as the clovers and winter rye. The humus content of the soil plays a very important role in the scheme of soil fertility. Humus provides plant food and creates a favourable condition for the retention of soil moisture. It also improves the physical condition of soils and makes fertilizers more effective. The analysis and amount of fertilizer to be used should be based on a chemical analysis of the soil.

3. Early Planting.

There has been a great deal of controversy among potato growers as to the best date on which to plant potatoes.

Results of experiments conducted in Middlesex and South Simcoe Counties indicate that from the 18th to the 25th of May is the most desirable time to plant. These results are supported by similar findings at the Ontario Agricultural College, Guelph, and the Central Experimental Farm, Ottawa.

TABLE No. 1

RESULTS OF DATES OF PLANTING EXPERIMENT IN MIDDLESEX AND SOUTH SIMCOE COUNTIES

TWO YEAR AVERAGE 1938-1939

Variety	Date of Planting	Yield Marketable Potatoes
Dooley	May 18	274 bus. per acre
"	May 25	248 " " "
"	June 2	224 " " "
"	June 10	198 " " "

4. Efficient Spraying

The value and importance of an efficient and regular spray schedule in potato production has become an established fact.

Investigations conducted by many experimental stations on the North American continent have proven that efficient spraying with Bordeaux mixture throughout the growing season increases the yield of marketable tubers on an average of 75 to 100 bushels per acre. The benefits of Bordeaux consist in its repellent effect on certain insects and in its control of fungus diseases, such as Early and Late Blight.

In 1936 a spraying trial was conducted on a farm in Middlesex County to prove the value of this practice. One half of the field was sprayed three times, using a 4-4-40 Bordeaux mixture. In two of the sprays calcium arsenate was added to control the Colorado potato beetle. The spray was applied at the rate of approximately 100 gallons per acre with a sprayer operating at 250-300 pounds pressure. The balance of the field received two applications of poison spray to control the Colorado potato beetle. The results of the experiment are presented in Table No. 2.



The neighbors gather to study the experimental plots and talk things over.

TABLE No. 2
RESULT OF SPRAYING TEST, MIDDLESEX COUNTY, 1936

Variety	Yield of Marketable Potatoes in Bus. per Acre		
	Sprayed	Check	Increase Over Check
Dooley -----	269	233	36

The Department of Botany, Ontario Agricultural College, Guelph, in co-operation with the Ridgetown Experimental Farm, has conducted spray and dust experiments with potatoes for eight successive years. The results of this work have shown that the plots that were thoroughly sprayed or dusted five times during the growing season gave an average increased yield of approximately 28% more marketable potatoes than the unsprayed or undusted plots.

5. Proper Methods in Harvesting, Grading, Packaging and Labelling

Regardless of the amount of care and attention that has been devoted to the growing of the potato crop, if proper methods are not followed in harvesting, grading, packaging, and labelling the product, the returns that otherwise might have been profitable may be very disappointing. It must be remembered that the reason for production is consumption. The consumer is the final judge in the matter. In most instances consumers are willing to pay a premium for a good article. There is no staple article of food brought into the average home that has greater appeal to the housewife than good, bright, clean potatoes of a uniform size, free from bruises and disease, and put up in a clean, attractive container.

DEMONSTRATIONS WITH POTATOES IN MIDDLESEX, SOUTH SIMCOE, YORK, AND ONTARIO COUNTIES

Treatment

All demonstration plots received the same quantity of barnyard manure as was applied to the general potato crop grown by each individual farmer. In addition, 750 pounds of a 4-8-10 fertilizer was applied in all cases to the demonstration plots. Certified or equivalent seed was used, and this was treated with a mercury solution before the sets were cut. Early planting was practised, and five sprayings with a 4-4-40 Bordeaux mixture, plus enough poison to control the Colorado potato beetle, were given during the growing season. This was applied at the rate of 80 to 100 gallons per acre at 250-300 pounds pressure. Cultivation was in accord with good cultural practices.

No commercial fertilizer was used on the check plots. Only enough poison spray was applied to control the Colorado potato beetle. The seed used to plant the check plots in 1937 and 1938 was uncertified seed of the same variety as used to plant the demonstration acres. Since these plots were of necessity planted adjacent to each other, it was impossible to obtain certification for the demonstration acre because of regulations requiring that potatoes entered for inspection be 200 feet distant from any other potato crop. As one object of the demonstration work was to encourage the purchase and use of certified seed, it was thought advisable to use certified stock exclusively to plant both the demonstration and check plots in 1939 and 1940. As a result of this policy, any improvement in yield or quality in the demonstration acre as compared with the check in these two years was due to fertilization and a more complete spraying programme.



POTATO CLUB BOYS MAKE FIELD OBSERVATIONS

Mr. Parks tells them, "This is the kind to grow, boys,—smooth and clean and uniform—but you see it takes suitable soil with balanced fertility, sound seed, careful cultivation, and thorough spraying to do it."

Results Obtained

TABLE No. 3
AVERAGE OF THE RESULTS OF 57 DEMONSTRATION ACRES
OVER 4-YEAR PERIOD

	Yield in Bushels per Acre	Per cent Marketable
Check Plots	238	79
Demonstration Plots	456	91
Increase over Check	218	12

The average increased yield of tubers of the 57 demonstration plots over the checks was 218 bushels per acre.

TABLE No. 4
RESULTS DEMONSTRATION POTATO WORK BY DISTRICTS
1937-1940

County	Demonstration Plots			Check Plots			Aver. Increased Yield Marketable Potatoes per acre Demonstration Over Check Plots
	Aver. Yield	Per cent Marketable	Aver. Bus. Per Acre Marketable	Aver. Yield	Per cent Marketable	Aver. Bus. Per Acre Marketable	
Middlesex— 3 years, 38 tests ..	373	92	343	232	83	193	150
South Simcoe— 1 year, 7 tests	453	88	401	269	78	218	183
York— 1 year, 6 tests	492	93	456	231	75	190	266
Ontario— 1 year, 6 tests	505	92	465	222	80	178	287

Note:—All yields are computed on a perfect stand basis, and to the nearest bushels. Yields computed in this way are on an average 15% higher than actual yields.

Comparison of Costs

The costs for seed and other materials used for both the demonstration and check plots were based on the average price prevailing over the four year period. Labour for spraying was charged at an average of 65c per hour for man and team, and one hour allowed for each spray per acre. No charge was made for the use of machinery or labour for planting, cultivating or harvesting the crops.

The returns from both the demonstration and check plots were computed at 70c per bushel for No. 1 Commercial potatoes. This has been the average price obtained by growers for this grade of potatoes over the four year period.

TABLE No. 5

EXPENSES INCURRED IN DEMONSTRATION AND CHECK PLOTS

Item	Demonstration Plot	Check Plot
Seed (average price 4 years)	\$20.55	\$18.65
Fertilizer	12.90	-----
Spray Materials	3.60	.80
Labour for spraying	3.25	1.30
Total	\$40.30	\$20.75

Increased Cost of Demonstration Plot—\$19.55 per acre.

The average revenue secured from the demonstration areas in comparison with the check plots is presented in Table No. 6.

TABLE No. 6

RETURNS FROM DEMONSTRATION AND CHECK PLOTS

	Demonstration Plots	Check Plots
Average Yields of Marketable Tubers, Bushels per Acre	416	195
Cash Value of Crop	\$291.20	\$136.50
Increased Value of Crop	\$154.70	-----

Comparison of Returns

Increased Value of Crop in Demonstration Plots over Check	\$154.70
Additional Cost of Producing Crop on Demonstration Plots	\$ 19.55
Increased Returns from Demonstration Acre over Check	\$135.15

Summary

Much higher yields can be obtained from potatoes when grown on suitable soil if proper methods are practised in growing and handling the crop.

Growers should recognize that financial returns are not necessarily measured by the number of acres grown, but by the yield of good quality tubers produced per acre.

The objective of Ontario potato growers should be, "More bushels of high quality potatoes from fewer acres."

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